South Indian Education Society's

Graduate School of Technology

NAAC 'A+', NBA Accredited(EXTC,CE,IT)

Autonomous Institute Affiliated to University of Mumbai

Department of Artificial Intelligence and Machine Learning

Curriculum Structure FE to B.E

and

Second Year Syllabi

Board of Studies
Department of Artificial Intelligence and Machine Learning

Academic Council
SIES Graduate School of Technology

Effective from: AY 2025-26

PREAMBLE

PREAMBLE

Dear Students and Stakeholders,

We are thrilled to unveil the newly developed autonomous curriculum at the SIES Graduate School of Technology's Department of Artificial Intelligence and Machine Learning (AIML). This cutting-edge program is designed to foster creativity, cultivate excellence, and adapt to the ever-evolving demands of society, all of which will enhance the nation's technological capabilities and global competitiveness.

The Department has meticulously crafted its curriculum using a top-down approach. This process involves setting clear, measurable learning objectives, aligning course content with these objectives, incorporating experiential learning through projects, skill labs, internships, and industry partnerships, mapping program outcomes (as outlined in the Self-Assessment Report by the NBA in January 2016) to individual courses, and establishing a framework for continuous evaluation and improvement. The process begins with stakeholder consultations to identify industry needs, leading to the introduction of four honors/minor tracks—Cyber Security, AIML, Data Science, and Blockchain.

The curriculum for program electives, laboratory courses, core courses, and honors/minor tracks has been carefully designed to reflect current industry trends. We've included courses that will equip our graduates with the skills needed to thrive in various industries across India.

Our program aligns with the trans-formative vision of the National Education Policy (NEP) 2020, providing students with a comprehensive understanding of key subjects such as artificial intelligence, machine learning, data science, and computational algorithms. Through interdisciplinary courses, skill labs, and specially tailored laboratory courses, students gain the skills to tackle complex challenges. Independent lab courses introduce students to practical engineering concepts like Machine Learning, Data Visualization Techniques, Deep Learning, and Natural Language Processing. The curriculum also offers electives in diverse fields such as Cloud Computing, Blockchain Technology, Security with AI, Pattern Recognition, and Reinforcement Learning, catering to a wide array of student interests.

Within this autonomous curriculum, teachers have numerous opportunities to innovate and enhance the learning experience for students. Faculty members can engage in research and development projects, actively participate in curriculum development, and offer internships that provide students with unique experiences. Instructors can also collaborate with industry associations to enrich the curriculum through relevant projects, internships, and guest lectures. Overall, curriculum autonomy empowers instructors to play a significant role in shaping the educational journey in Artificial Intelligence Machine Learning.

By nurturing creativity, resilience, and a curious mindset, we aim to prepare our graduates to become leaders, innovators, and global ambassadors of excellence in the field of Artificial Intelligence Machine Learning. We invite all interested parties to join us on this transformative journey to redefine engineering education. Together, let's strive for excellence, innovation, and a positive impact on society.

Vopatil

Chairperson
Board of Studies
Artificial Intelligence and Machine Learning
SIES Graduate School of Technology

Chairperson
Academic Council
SIES Graduate School of Technology

HEAD of the Department
Artificial Intelligence & Machine Learning
SIES. Graduate School of Technology
Sri Chandrasekarendra Saraswathy Vidyapuram
Plot-1-C & E, Sector-V, Nerul, Navi Mumbai-400706

PRINCIPAL
S.I.E.S. GRADUATE SCHOOL OF TECHNOLOGY (AUTONOMOUS)
Plot 1C/D/E, Sri Chandrasekarendra Saraswathy Vidyapuram
Sector - V, Nerul, Navi Mumbai - 400 706.

Semester wise Credit distribution structure for Four Year UG Engineering

Program - Artificial Intelligence and Machine Learning: One Major, One Minor

Semester		I	II	III	IV	V	VI	VII	VIII	Total Credits
Basic Science Course (BSC)	BSC/ESC	07	06	--	--	--	--	--	--	13
Engineering Science Course (ESC)		09	10	--	--	--	--	--	--	19
Programme Core Course (PCC)	Program Courses	--	--	17	11	12	12	04	--	56
Programme Elective Course (PEC)		--	--	--	--	03	03	07	--	13
Multidisciplinary Minor (MDM)	Multidisciplinary Courses	--	--	--	03	04	04	04	--	15
Open Elective(OE) Other than a particular program		--	--	--	--	--	--	03	03	06
Vocational and Skill Enhancement Course (VSEC)	Skill Courses	01	01	02	02	--	02	--	--	08
Ability Enhancement Course (AEC - 01, AEC-02)	Humanities Social Science and Management (HSSM)	--	02	--	--	02	--	--	--	04
Entrepreneurship/Economics/ Management Courses		--	--	02	02	--	--	--	--	04
Indian Knowledge System (IKS)		--	02	--	--	--	--	--	--	02
Value Education Course (VEC)		--	--	--	02	--	--	--	--	02
Research Methodology(RM)	Experiential Learning Courses	--	--	--	--	--	--	--	03	03
Community Engagement Project (CEP) / Field Project (FP)		--	--	01	01	--	--	–	-	02
Project		--	--	--	--	01	01	02	02	06
Internship/On Job Training (OJT)		--	---	--	--	--	--	--	09	09
Co-curricular Courses(CC)	Liberal Learning Courses	04	--	--	--	--	--	--	-	04
Total Credits (Major)		**21**	**21**	**22**	**21**	**22**	**22**	**20**	**17**	**166**

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CURRICULUM STRUCTURE

SECOND YEAR ENGINEERING

(ARTIFICIAL INTELLIGENCE

and MACHINE LEARNING)

Academic Year 2025-26

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Nomenclature of the courses in the curriculum	
Abbreviation	**Title**
BSC	Basic Science Courses
ESC	Engineering Science Courses
PCC	Program Core Courses
PEC	Program Elective Course
MDM	Multidisciplinary Minor
OE	Open Elective
VSEC	Vocational and Skill Enhancement Course
AEC	Ability Enhancement Course
IKS	Indian Knowledge System
VEC	Value Education Course
RM	Research Methodology
CEP/FP	Community Engagement Project/Field Pro
OJT	Internship/On Job Training
CC	Co-curricular Courses
ISE	In Semester Examination
MSE	Mid Semester Examination
ESE	End Semester Examination
CIAP	Continuous Internal Assessment Practical
ESEP	End Semester Examination Practical

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Program Structure for First Year
W.E.F. A.Y. 2024-25
Semester I

Course Code	Course Name	Category	Teaching Scheme(Contact Hours)			Credits Assigned			
			Theory	Pract	Tut.	Theory	Pract.	Tut.	Total
FEC101	Applied Mathematics-I	BSC	3	--	--	3	--	--	3
FEC1021/ FEC1022	Applied Physics/Applied Chemistry@	BSC	3	--	--	3	--	--	3
FEC103	Basic Electrical&Electronics Engineering	ESC	2	--	--	2	--	--	2
FEC104	C-Programming	ESC	2	--	--	2	--	--	2
FEC105	Applied Mechanics and Robot Dynamics	ESC	2	--	--	2	--	--	2
FEL1011/ FEL1012	Applied Physics Lab/Applied Chemistry Lab@	BSC	--	1	--	--	0.5	--	0.5
FEL102	Basic Electrical &Electronics Engineering Lab	ESC	--	2	--	--	1	--	1
FEL103	C-Programming Lab	ESC	--	2	--	--	1	--	1
FEL104	Applied Mechanics and Robot Dynamics Lab	ESC	--	2	--	--	1	--	1
FEL105	Engineering Workshop-I	VSEC	--	2	--	--	1	--	1
FEL106	Health,Wellness and Mindfulness	CC	--	2#+2	--	--	2	--	2
FEL107	Induction Cum Universal Human Values	CC	--	5*	--	--	2.5	--	2.5

Examination Scheme-FY Semester-I

Course Code	Course Name	Examination Scheme						
		Theory				CIAP	ESEP	Total
		Internal Assessment		ESE$	Exam Duration (Hrs.)			
		ISE	MSE					
FEC101	Applied Mathematics -I	20	20	60	3	--	--	100
FEC1021/ FEC1022	Applied Physics/ Applied Chemistry @	20	20	60	3	--	--	100
FEC103	Basic Electrical & Electronics Engineering	15	15	45	2	--	--	75
FEC104	C-Programming	15	15	45	2	--	--	75
FEC105	Applied Mechanics and Robot Dynamics	15	15	45	2	--	--	75
FEL1011/ FEL1012	Applied Physics Lab/ Applied Chemistry Lab@	--	--	--	--	25	--	25
FEL102	Basic Electrical & Electronics Engineering Lab	--	--	--	--	25	25	50
FEL103	C-Programming Lab	--	--	--	--	25	25	50
FEL104	Applied Mechanics and Robot Dynamics Lab	--	--	--	--	25	25	50
FEL105	Engineering Workshop-I	--	--	--	--	25	--	25
FEL106	Health, Wellness and Mindfulness	--	--	--	--	25	--	25
FEL107	Induction Cum Universal Human Values	--	--	--	--	25	--	25
Total		**85**	**85**	**255**		**175**	**75**	**675**

@Physics/Chemistry in one semester.
$ ESE of duration 3 hours are of 80 marks and scaled to 60. ESE duration of 2 hours are of 60 marks and scaled to 45.
Theory 1 credit for 1 hour and practical 1 credit for 2 hours.
*Indicates workload of a learner for UHV. Faculty Load: ½ hour per week per four groups
Two hours of practical class to be conducted for full class as demo/ discussion.
ISE: In Semester Examination**:** To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test etc. of 20/15 marks.
MSE: Mid Semester Examination: To be conducted as written examination for 20/15 marks of duration 1 Hr.
ESE: End Semester Examination
CIAP: Continuous Internal Assessment Practical. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).
ESEP: End Semester Examination Practical. Oral/Practical Examination will be conducted as End Semester Examination Practical (ESEP).

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Program Structure for First Year
W.E.F. A.Y. 2024-25
Semester II

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)			Credits Assigned			
			Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
FEC201	Applied Mathematics -II	BSC	3	--	--	3	--	--	3
FEC2021/ FEC1022	Applied Physics/ Applied Chemistry@	BSC	3	--	--	3	--	--	3
FEC203	Engineering Graphics	ESC	2	--	--	2	--	--	2
FEC204	Digital System Design	ESC	3	--	--	3	--	--	3
FEC205	Professional Communication Techniques	AEC	2	--	--	2	--	--	2
FEL2011/ FEL2012	Applied Physics Lab/ Applied Chemistry Lab@	BSC	--	1	--	--	0.5	--	0.5
FEL202	Engineering Graphics Lab	ESC	--	2	--	--	1	--	1
FEL203	Digital System Design Lab	ESC	--	2	--	--	1	--	1
FEL204	Professional Communication Techniques Lab	AEC	--	1	--	--	0.5	--	0.5
FEL205	Object Oriented Programming Methodology Lab	ESC	--	2*+2	--	--	2	--	2
FEL206	Engineering Workshop-II	VSEC	--	2	--	--	1	--	1
FEL207	Indian Knowledge System	HSSM	--	2*+2	--	--	2	--	2
	Total		**13**	**16**	--	**13**	**8**	--	**21**

Examination Scheme-FY Semester-II

Course Code	Course Name	Examination Scheme						
		Theory				CIAP	ESEP	Total
		Internal Assessment		ESE$	Exam Duration (Hrs.)			
		ISE	MSE					
FEC201	Applied Mathematics -II	20	20	60	03	--	--	100
FEC2021/ FEC2022	Applied Physics/ Applied Chemistry@	20	20	60	03	--	--	100
FEC203	Engineering Graphics	15	15	45	03	--	--	75
FEC204	Digital System Design	20	20	60	03	--	--	100
FEC205	Professional Communication Techniques	15	15	45	02	--	--	75
FEL2011/ FEL2012	Applied Physics Lab/ Applied Chemistry Lab@	--	--	--	--	25	--	25
FEL202	Engineering Graphics Lab	--	--	--	--	25	25	50
FEL203	Digital System Design Lab	--	--	--	--	25	25	50
FEL204	Professional Communication Techniques Lab	--	--	--	--	25	--	25
FEL205	Object Oriented Programming Methodology Lab	--	--	--	--	25	25	50
FEL206	Engineering Workshop-II	--	--	--	--	25	--	25
FEL207	Indian Knowledge System	--	--	--	--	25	--	25
Total		**90**	**90**	**270**	--	**175**	**75**	**700**

@Physics/Chemistry in one semester.
* Two hours of practical class to be conducted for full class as demo/ discussion.
# Course evaluation is an activity based which may be an individual or group of students.
$ ESE of duration 3 hours are of 80 marks and scaled to 60. ESE duration of 2 hours are of 60 marks and scaled to 45.
Theory 1 credit for 1 hour and practical 1 credit for 2 hours.
ISE: In Semester Examination**:** To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test etc. of 20/15 marks.
MSE: Mid Semester Examination: To be conducted as written examination for 20/15 marks of duration 1 Hr.
ESE: End Semester Examination
CIAP: Continuous Internal Assessment Practical. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).
ESEP: End Semester Examination Practical. Oral/Practical Examination will be conducted as End Semester Examination Practical (ESEP).

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Program Structure for Second Year

W.E.F. A.Y. 2025-26

Semester III

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)			Credits Assigned			
			Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
AIMLC301	Applied Mathematics III	PCC	3	--	--	3	--	--	3
AIMLC302	Data Structure	PCC	3	--	--	3	--	--	3
AIMLC303	Discrete Structure	PCC	3	--	--	3	--	--	3
AIMLC304	Database Management Systems	PCC	3	--	--	3	--	--	3
AIMLC305	Computer Organization and Architecture	PCC	2	--	--	2	--	--	2
AIMLC306	Engineering Economics	HSSM	2	--	--	2	--	--	2
AIMLL301	Data Structure Lab	PCC	--	2	--	--	1	--	1
AIMLL302	Database Management Systems Lab	PCC	--	2	--	--	1	--	1
AIMLL303	Computer Organization and Architecture Lab	PCC	--	2	--	--	1	--	1
AIMLL304	Skill Lab (Python Programming)	VSEC	--	2*+2	--	--	2	--	2
AIMLM301	Mini Project 1A	CEP	--	2#	--	--	1	--	1
Total			**16**	**12**	**--**	**16**	**6**	**--**	**22**

Examination Scheme - AIML Semester-III

Course Code	Course Name	Examination Scheme						
		Theory				CIAP	ESEP	Total
		Internal Assessment		ESE$	Exam Duration (Hrs.)			
		ISE	MSE					
AIMLC301	Applied Mathematics III	20	20	60	3	--	--	100
AIMLC302	Data Structure	20	20	60	3	--	--	100
AIMLC303	Discrete Structure and Graph Theory	20	20	60	3	--	--	100
AIMLC304	Database Management Systems	20	20	60	3	--	--	100
AIMLC305	Computer Organization and Architecture	15	15	45	2	--	--	75
AIMLC306	Engineering Economics	50				--	--	50
AIMLL301	Data Structure Lab	--	--	--	--	25	25	50
AIMLL302	Database Management Systems Lab	--	--	--	--	25	25	50
AIMLL303	Computer Organization and Architecture Lab	--	--	--	--	25	--	25
AIMLL304	Skill Lab (Python Programming)	--	--	--	--	25	25	50
AIMLM301	Mini Project 1A	--	--	--	--	25	25	50
Total		**145**	**95**	**285**	**--**	**125**	**100**	**750**

* Two hours of practical class to be conducted for full class as demo/ discussion.

# Indicates workload of a learner (Not faculty) for Mini Project 1A. Faculty Load: ½ hour per week per four groups

$ ESE of duration 3 hours are of 80 marks and scaled to 60. ESE duration of 2 hours are of 60 marks and scaled to 45.

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Program Structure for Second Year

W.E.F.A.Y.2025-26

Semester IV

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)			Credits Assigned			
			Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
AIMLC401	Applied Mathematics-IV	PCC	3	--	--	3	--	--	3
AIMLC402	Operating System	PCC	3		--	3	--	--	3
AIMLC403	Analysis of Algorithm	PCC	3		--	3	--	--	3
AIMLC404	Critical Thinking and Design	HSSM	2	--	--	2	--	--	2
MDMC40X1	Multidisciplinary Minor (MDM –I)	MDM	3	--	--	3	--	--	3
AIMLL401	Operating System Lab	PCC	--	2	--	--	1	--	1
AIMLL402	Analysis of Algorithm Lab	PCC	--	2	--	--	1	--	1
AIMLL403	Skill Lab (Linux System and Networking Lab)	VSEC	--	2*+2	--	--	2	--	2
AIMLL404	Value Education (UHV)	HSSM (VEC)	--	4	--	--	2	--	2
AIMLM401	Mini Project 1B	CEP	--	2#	--	--	1	--	1
Total			**14**	**16**	**--**	**14**	**7**	**--**	**21**

Examination Scheme - AIML Semester-IV

Course Code	Course Name	Examination Scheme						
		Theory				CIAP	ESEP	Total
		Internal Assessment		ESE$	Exam Duration (Hrs.)			
		ISE	MSE					
AIMLC401	Applied Mathematics-IV	20	20	60	3	--	--	100
AIMLC402	Operating System	20	20	60	3	--	--	100
AIMLC403	Analysis of Algorithm	20	20	60	3	--	--	100
AIMLC404	Critical Thinking and Design	15	15	45	2	--	--	75
MDMC40X1	Multidisciplinary Minor (MDM –I)	20	20	60	3	--	--	100
AIMLL401	Operating System Lab	--	--	--	--	25	25	50
AIMLL402	Analysis of Algorithm Lab	--	--	--	--	25	25	50
AIMLL403	Skill Lab (Linux System Administration and Security)	--	--	--	--	25	25	50
AIMLL404	Value Education (UHV)	--	--	--	--	50	--	50
AIMLM401	Mini Project 1B	--	--	--	--	25	25	50
Total		**95**	**95**	**285**	**--**	**150**	**100**	**725**

* Two hours of practical class to be conducted for full class as demo/ discussion.
# Indicates workload of a learner (Not faculty) for Mini Project 1B. Faculty Load: ½ hour per week per four groups
$ ESE of duration 3 hours are of 80 marks and scaled to 60. ESE duration of 2 hours are of 60 marks and scaled to 45.

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Program Structure for Third Year

W.E.F.A.Y.2026-27

Semester V

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)			Credits Assigned			
			Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
AIMLC501	Artificial Intelligence	PCC	3	--	--	3	--	--	3
AIMLC502	Data Mining and Data Engineering	PCC	3	--	--	3	--	--	3
AIMLC503	Web Technology	PCC	3	--	--	3	--	--	3
MDMC50X2	Multidisciplinary Minor (MDM -II)	MDM	3	--	--	3	--	--	3
AIMLPEC501X	Program Elective-I	PEC	3	--	--	3	--	--	3
AIMLL501	Artificial Intelligence Lab	PCC	--	2	--	--	1	--	1
AIMLL502	Data Mining and Data Engineering Lab	PCC	--	2	--	--	1	--	1
AIMLL503	Web Technology Lab	PCC	--	2	--	--	1	--	1
AIMLL504	Professional Communication and Ethics Lab	AEC	--	2*+2	--	--	2	--	2
MDML50X2	Multidisciplinary Minor (MDM -II) Lab	MDM	--	2	--	--	1	--	1
AIMLM501	Mini Project 2A	MP	--	2#	--	--	1	--	1
Total			**15**	**14**	**--**	**15**	**7**	**--**	**22**

Examination Scheme - AIML Semester-V

Course Code	Course Name	Examination Scheme						
		Theory				CIAP	ESEP	Total
		Internal Assessment		ESE$	Exam Duration (Hrs.)			
		ISE	MSE					
AIMLC501	Artificial Intelligence	20	20	60	3	--	--	100
AIMLC502	Data Mining and Data Engineering	20	20	60	3	--	--	100
AIMLC503	Web Technology	20	20	60	3	--	--	100
MDMC50X2	Multidisciplinary Minor (MDM -II)	20	20	60	3	--	--	100
AIMLPEC501X	Program Elective-I	20	20	60	3	--	--	100
AIMLL501	Artificial Intelligence Lab	--	--	--	--	25	25	50
AIMLL502	Data Mining and Data Engineering Lab	--	--	--	--	25	25	50
AIMLL503	Web Technology Lab	--	--	--	--	25	--	25
AIMLL504	Professional Communication and Ethics Lab	--	--	--	--	50	--	50
MDML50X2	Multidisciplinary Minor (MDM -II) Lab	--	--	--	--	25	25	50
AIMLM501	Mini Project 2A	--	--	--	--	25	25	50
Total		**100**	**100**	**300**		**175**	**100**	**775**

* Two hours of practical class to be conducted for full class as demo/ discussion.

# Indicates workload of a learner (Not faculty) for Mini Project 2A. Faculty Load: ½ hour per week per four groups

$ ESE of duration 3 hours are of 80 marks and scaled to 60. ESE duration of 2 hours are of 60 marks and scaled to 45.

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Program Elective – I

Technology Bucket			
Computational Intelligence	**Intelligent Systems**	**Industry Automation & Robotics**	**Extended Reality**
AIMLPEC5011: Statistical Signal Analysis for Data Science	**AIMLPEC5012:** Image and Video Processing	**AIMLPEC5013:** Fundamentals of Industrial Automation	**AIMLPEC5014:** Mobile & Game Development

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Program Structure for Third Year

W.E.F.A.Y.2026-27

Semester VI

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract.	Theory	Pract.	Total
AIMLC601	Machine Learning	PCC	3	--	3	--	3
AIMLC602	Natural Language Processing	PCC	3	--	3	--	3
AIMLC603	Software Engineering and Project Management	PCC	3	--	3	--	3
MDMC60X3	Multidisciplinary Minor (MDM -III)	MDM	3	--	3	--	3
AIMLPEC601X	Program Elective-II	PEC	3	--	3	--	3
AIMLL601	Machine Learning Lab	PCC	--	2	--	1	1
AIMLL602	Natural Language Processing ab	PCC	--	2	--	1	1
AIMLL603	Software Engineering and Project Management Lab	PCC	--	2	--	1	1
AIMLL604	Skill Lab – DevOps Lab	VSEC	--	2*+2	--	2	2
MDML60X3	Multidisciplinary Minor (MDM -III) Lab	MDM	--	2	--	1	1
AIMLM601	Mini Project 2B	MP	--	2#	--	1	1
Total			**15**	**14**	**15**	**7**	**22**

Examination Scheme - AIML Semester-VI

Course Code	Course Name	Examination Scheme						
		Theory				CIAP	ESEP	Total
		Internal Assessment		ESE$	Exam Duration (Hrs.)			
		ISE	MSE					
AIMLC601	Machine Learning	20	20	60	3	--	--	100
AIMLC602	Natural Language Processing	20	20	60	3	--	--	100
AIMLC603	Software Engineering and Project Management	20	20	60	3	--	--	100
MDMC60X3	Multidisciplinary Minor (MDM -III)	20	20	60	3	--	--	100
AIMLPEC601X	Program Elective-II	20	20	60	3	--	--	100
AIMLL601	Machine Learning Lab	--	--	--	--	25	25	50
AIMLL602	Natural Language Processing ab	--	--	--	--	25	25	50
AIMLL603	Software Engineering and Project Management Lab	--	--	--	--	25	--	25
AIMLL604	Skill Lab – DevOps Lab	--	--	--	--	25	25	50
MDML60X3	Multidisciplinary Minor (MDM -III) Lab	--	--	--	--	25	25	50
AIMLM601	Mini Project 2B	--	--	--	--	25	25	50
Total		**100**	**100**	**300**	**--**	**150**	**125**	**775**

* Two hours of practical class to be conducted for full class as demo/ discussion.

# Indicates workload of a learner (Not faculty) for Mini Project 2B. Faculty Load: ½ hour per week per four groups

$ ESE of duration 3 hours are of 80 marks and scaled to 60. ESE duration of 2 hours are of 60 marks and scaled to 45.

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Program Elective – II

Technology Bucket			
Computational Intelligence	**Intelligent Systems**	**Industry Automation & Robotics**	**Extended Reality**
AIMLPEC6011: Soft Computing	**AIMLPEC6012:** Geographic Information System	**AIMLPEC6013:** Wireless Sensor Technology	**AIMLPEC6014:** UX/UI Design

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Program Structure for Fourth Year
W.E.F.A.Y.2027-28
Semester VII

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract.	Theory	Pract.	Total
AIMLC701	Deep Learning	PCC	3	--	3	--	3
MDMC70X4	Multidisciplinary Minor (MDM -IV)	MDM	3	--	3	--	3
AIMLPEC701X	Program Elective-III	PEC	3	--	3	--	3
AIMLPEC702X	Program Elective-IV	PEC	3	--	3	--	3
OEC701X	Open Elective-I	OE	3	--	3	--	3
AIMLL701	Deep Learning Lab	PCC	--	2	--	1	1
MDML70X4	Multidisciplinary Minor (MDM -IV) Lab	MDM	--	2	--	1	1
AIMLPEL702X	Program Elective-III Lab	PEC	--	2	--	1	1
AIMLP701	Major Project Stage-I	MJP	--	4#	--	2	2
Total			**15**	**10**	**15**	**5**	**20**

Examination Scheme - AIML Semester-VII

Course Code	Course Name	Examination Scheme						
		Theory				CIAP	ESEP	Total
		Internal Assessment		ESE$	Exam Duration (Hrs.)			
		ISE	MSE					
AIMLC701	Deep Learning	20	20	60	3	--	--	100
MDMC70X4	Multidisciplinary Minor (MDM -IV)	20	20	60	3	--	--	100
AIMLPEC701X	Program Elective-III	20	20	60	3	--	--	100
AIMLPEC702X	Program Elective-IV	20	20	60	3	--	--	100
OEC701X	Open Elective-I	20	20	60	3	--	--	100
AIMLL701	Deep Learning Lab	--	--	--	--	25	25	50
MDML70X4	Multidisciplinary Minor (MDM -IV) Lab	--	--	--	--	25	25	50
AIMLPEL702X	Program Elective-III Lab	--	--	--	--	25		25
AIMLP701	Major Project Stage-I	--	--	--	--	25	25	50
Total		**100**	**100**	**300**	**--**	**100**	**75**	**675**

#Indicates workload of Learner (Not faculty), for Major Project
Project Guide Load = ½ hour per week per project group
$ ESE of duration 3 hours are of 80 marks and scaled to 60. ESE duration of 2 hours are of 60 marks and scaled to 45.

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Program Elective-III

Technology Bucket			
Computational Intelligence	**Intelligent Systems**	**Industry Automation & Robotics**	**Extended Reality**
AIMLPEC7011: Advanced AI	**AIMLPEC7012:** Pattern Recognition & Computer Vision	**AIMLPEC7013:** Machine Learning for Robotics	**AIMLPEC7014:** AR/VR

Program Elective-IV

Technology Bucket			
Computational Intelligence	**Intelligent Systems**	**Industry Automation & Robotics**	**Extended Reality**
AIMLPEC7021: Big Data Anaytics	**AIMLPEC7022:** Game Theory for Data Science	**AIMLPEC7023:** AI in Manufacturing and Industry 4.0	**AIMLPEC7024:** Quantum Computing

Open Elective-I

Course Code	Course Name
OEC7011	Project Management
OEC7012	Finance Management
OEC7013	Management Information System
OEC7014	Entrepreneurship Development and Management
OEC7015	Operation Research
OEC7016	Disaster Management and Mitigation Measures
OEC7017	Product Design

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Program Structure for Fourth Year
W.E.F.A.Y.2027-28
Semester VIII

Course Code	Course Name	Category	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract.	Theory	Pract.	Total
AIMLC801	Research Methodology	RM	3	--	3	--	3
OEC801X	Open Elective-II	OE	3	--	3	--	3
AIMLP801	Major Project Stage-II	MJP	--	4#	--	2	2
AIMLINT801	Internship/Project/Research	Internship	--	--	--	9	9
Total			**6**	**4**	**6**	**11**	**17**

Examination Scheme - AIML Semester-VIII

Course Code	Course Name	Examination Scheme						
		Theory				CIAP	ESEP	Total
		Internal Assessment		ESE$	Exam Duration (Hrs.)			
		ISE	MSE					
AIMLC801	Research Methodology	20	20	60	3	--	--	100
OEC801X	Open Elective	20	20	60	3	--	--	100
AIMLP801	Major Project Stage-II	--	--	--	--	100	50	150
AIMLINT801	Internship/Project/ Research	--	--	--	--	200	--	200
Total		40	40	120	--	300	50	550

#Indicates workload of Learner (Not faculty), for Major Project
Project Guide Load = ½ hour per week per project group
$ ESE of duration 3 hours are of 80 marks and scaled to 60. ESE duration of 2 hours are of 60 marks and scaled to 45.

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Open Elective -II

Course Code	Course Name
OEC8011	Enterprise Resource Planning
OEC8012	Cyber Security and Laws
OEC8013	Energy Audit and Management
OEC8014	IPR and Patenting
OEC8015	Environmental Management
OEC8016	Digital Business Management
OEC8017	Human Resource Management

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Multidisciplinary Minor (MDM)

Track	Minor Track	Partner Institute if any	Module	Code	Eligible
1	ML	SIES GST	Artificial Intelligence	MDMC4011	IT/EXTC/CSE IOT
			Machine Learning	MDMC5012	
			Natural Language Processing	MDMC6013	
			Deep Learning	MDMC7014	
2	DS	SIES GST	Statistical Foundation for Data Science	MDMC4021	ECS/CE/EXTC
			Data Analytics & Visualization	MDMC5022	
			Decision Making & Business Intelligence	MDMC6023	
			Big Data Analytics	MDMC7024	
3	Embedded Systems	SIES GST	Microprocessor and Microcontrollers	MDMC4031	CE/AIDS/AIML
			RTOs and Embedded systems	MDMC5032	
			Sensor Technology	MDMC6033	
			Industrial Internet of Things	MDMC7034	
4	Cyber Security	SIES GST	Computer Network	MDMC4041	AIDS/AIML
			Cryptography & System Security	MDMC5042	
			Cloud Computing and Security	MDMC6043	
			Digital Forensics	MDMC7044	
5	System Programming	SIES GST	Advance Data Structure	MDMC4051	CSEIOT/ECS/IT
			Advance Algorithm	MDMC5052	
			System Programming and Compiler Construction	MDMC6053	
			Distributed Systems	MDMC7054	
6	Management	SIESSBS	Cost Management	MDMC4061	EXTC/CE/IT/ECS/AIDS/AIML/CSE IOT
			Supply Chain Management	MDMC5062	
			HR & Organization	MDMC6063	
			Marketing Management	MDMC7064	

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SIES Graduate School of Technology
Department of Artificial Intelligence and Machine Learning
Bachelor of Engineering

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
AIMLC301	Applied Mathematics -III	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
AIMLC301	Applied Mathematics-III	20	20	60	--	--	100

Pre- requisite:
1. FEC101- Applied Mathematics I
2. FEC201 - Applied Mathematics II

Program Outcomes Addressed
1. PO1: Engineering Knowledge
2. PO2: Problem analysis
3. PO3: Design/development of solutions
4. PO4: Conduct investigation of complex problems

Course Objectives:
1. To learn the Laplace transform of various functions and its applications.
2. To learn Inverse Laplace Transform of various functions and its applications.
3. To understand the concept of Fourier Series, its complex form and enhance the problem-solving skill.
4. To understand the concept of complex variables, C-R equations, harmonic functions and their conjugate and mapping in complex plan.
5. To familiarize with the concepts of statistics for data analysis.
6. To acquaint with the concepts of probability, random variables with their distributions and expectations.

Course Outcomes: Learners will be able to
1. Apply the properties of Laplace transform to the functions. Describe the various functions of Physical Layer.
2. Determine inverse Laplace transform using convolution theorem and partial fraction method.
3. Construct the Fourier series of periodic functions for real life problems and complex engineering problems.
4. Apply the concept of complex numbers, complex functions, and their significance in data science and engineering.

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5. Evaluate the strength and direction of relationships between variables using correlation and Regression techniques.
6. Apply the concepts of probability and expectation for getting the spread of the data and distribution of the data.

Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Laplace Transform**	**07**	
	1.1	Definition of Laplace transform: Condition of Existence of Laplace transform, Laplace Transform (L) of Standard Functions like $^{t}, \sin\ t\ , \cos\ t\ , \sin h\ t\ , \cos h\ t\ \ n\, t^{n}, n \geq 0$.		**CO1**
	1.2	Properties of Laplace Transform: Linearity, First shifting theorem, Second Shifting Transform, Change of Scale property, Multiplication by t, Division by t, Laplace Transform of derivatives and integrals (Properties without proof).		
	1.3	Evaluation of integrals for particular value of 's' by using Laplace Transformation.		
		Self-learning Topics: Heaviside's Unit Step function, Laplace Transform of Periodic functions, Dirac Delta Function.		
2.0		**Inverse Laplace Transform**	**06**	
	2.1	Introduction of Inverse Laplace Transform, Linearity property, Use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivatives.		**CO2**
	2.2	Partial fractions method to find inverse Laplace transform		
	2.3	Inverse Laplace transform using Convolution theorem (without proof).		
	2.4	Applications to solve initial and boundary value problems involving ordinary differential equations.		
		Self-learning Topics: Applications to solve simultaneous initial and boundary value problems involving ordinary differential equations.		
3.0		**Fourier Series**	**07**	
	3.1	Dirichlet's conditions, Definition of Fourier series.		**CO3**
	3.2	Fourier series of periodic functions with period 2 and 2l.		
	3.3	Fourier series of even and odd functions (No examples on Parseval Identity)		
	3.4	Half range Sine and Cosine Series.		
		Self-learning Topics: Complex form of Fourier Series, Orthogonal and orthonormal set of functions. Fourier Transform.		

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4.0		**Complex Variables**	**07**	
	4.1	Function f(z) of complex variable, limit, continuity and differentiability off(z) Analytic function, necessary and sufficient conditions for f(z) to be analytic (without proof).		**CO4**
	4.2	Cauchy-Riemann equations in cartesian coordinates (without proof).		
	4.3	Milne-Thomson method to determine analytic function f (z) when real part (u) or Imaginary part (v) or its combination (u+v or u-v) is given.		
	4.4	Harmonic function, Harmonic conjugate and orthogonal trajectories.		
		Self-learning Topics: Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations.		
5.0		**Statistical Techniques**	**06**	
	5.1	Karl Pearson's Coefficient of correlation (r) and related concepts with problems.		**CO5**
	5.2	Spearman's Rank correlation coefficient (R) (Repeated & non repeated ranks with problems).		
	5.3	Lines of regression.		
		Self-learning Topics: Covariance.		
6.0		**Probability Theory**	**06**	
	6.1	Total Probability theorem and Bayes' theorem.		**CO6**
	6.2	Discrete and continuous random variable with probability distribution and probability density function.		
	6.3	Expectation, Variance, Laws of expectation.		
	6.4	Moment generating function, Raw and central moments up to 4th order.		
		Self-learning Topics: Skewness and Kurtosis of distribution (data).		
		Total	**39**	

Textbooks:

1. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited, 10th Edition 2023-24.
2. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication, 45th edition.

Reference books:

1. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa Publication, 5th edition.
2. Complex Variables and Applications, Brown and Churchill, McGraw-Hill Education, 9th edition.

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3. Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill Eduction.
4. Theory and Problems of Fourier Analysis with applications to BVP, Murray Spiegel, Schaum's Outline Series.
5. Advanced Engineering Mathematics – H. K. Dass, S. Chand Publications, 2007.

Online References:

1. https://nptel.ac.in/courses
2. https://www.coursera.org/courses?query=advanced%20engineering%20mathematics

Course Assessment:

ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

MSE:

- To be conducted as written examination for 20 marks (on 40% - 50% syllabus)

End Semester Examination:

$ ESE of duration 03 hours are of 80 marks and scaled to 60.

1. Question paper will comprise of 03 questions.
2. Question1 (20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
3. Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
4. Question3 (20 marks):- Solve any 04 out of 06. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
AIMLC302	Data Structure	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE[$]			
		ISE	MSE				
AIMLC302	Data Structure	20	20	60	--	--	100

Pre- requisite:

1. FEC104 – C Programming

Program Outcomes Addressed

1. PO1: Engineering Knowledge
2. PO2: Problem analysis
3. PO3: Design/development of solutions
4. PO4: Conduct investigation of complex problems
5. PO11: Life-long learning

Course Objectives:

1. To identify the need and significance of Data structures as a computer Professional.
2. To describe linear and nonlinear data structures.
3. To apply various operations on data structures and select the appropriate one to solve a specific real-world problem.
4. To analyze various techniques for representation of the data in the real world.
5. To understand various graph concepts.
6. To discuss arching and Hashing techniques

Course Outcomes: Learners will be able to

1. Illustrate linear and Non-Linear data structures.
2. Discuss operations on stack and queue.
3. Illustrate linked list data structures.
4. Apply operations like searching, insertion, deletion in the tree.
5. Analyze various operations of graph.
6. Apply various searching and hashing operations.

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Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Introduction to Data Structures**	**02**	
	1.1	**Introduction to Data Structures,** Concept of ADT, Types of Data Structures-Linear and Nonlinear, Operations on Data Structures, Applications of Data Structures		**CO1**
2.0		**Stack and Queues**	**08**	
	2.1	Introduction, ADT of Stack, Operations on Stack, Array Implementation of Stack, Applications of Stack-Well form-ness of Parenthesis, Infix to Postfix, Conversion and Postfix Evaluation, Recursion.		**CO2**
	2.2	Introduction, ADT of Queue, Operations on Queue, Array Implementation of Queue, Types of Queue-Circular Queue, Priority Queue, introduction of Double Ended Queue, Applications of Queue.		
		Self-learning Topics: Multiple queues. Variants of recursion. Case study on priority management.		
3.0		**Linked List**	**10**	
	3.1	Introduction, Representation of Linked List, Linked List v/s Array, Types of Linked List - Singly Linked List, Circular Linked List, Doubly Linked List, Operations on Singly Linked List and Doubly Linked List, Stack and Queue using Singly Linked List, Singly Linked List Application-Polynomial Representation and Addition, Generalized linked list.		**CO3**
		Self-learning Topics: Case study on linked lists.		
4.0		**Tree**	**11**	
	4.1	Introduction, Tree Terminologies, Binary Tree, Binary Tree Representation, Types of Binary Tree, Binary Tree Traversals, Binary Search Tree, Operations on Binary Search Tree, Applications of Binary Tree-Expression Tree, Huffman Encoding Search Trees-AVL, rotations in AVL Tree, operations on AVL Tree, Introduction of B Tree, B+ Tree.		**CO4**
		Self-learning Topics: Case study on trees. Threaded binary trees.		
5.0		**Graphs**	**04**	
	5.1	Introduction, Graph Terminologies-Representation of Graph, Graph Traversals-Depth First Search (DFS) and Breadth First Search (BFS), Graph Application-Topological Sorting. Applications of graph.		**CO5**
		Self-learning Topics: Data structures for web graph and google map.		
6.0		**Searching Techniques**	**04**	
	6.1	Linear Search, Binary Search, Hashing-Concept, Hash Functions-		**CO6**

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		division method, multiplication, mid-square and folding. Collision resolution Techniques-open addressing and chaining.		
		Self-learning Topics: Case study on hashing and collision		
		Total	**39**	

Textbooks:

1. Data Structures using C, Reema Thareja, 2nd Edition, 2014, Oxford Press.
2. Data Structures: A Pseudocode Approach with C, Richard F. Gilberg and Behrouz A. Forouzan, 2nd Edition, 2007, CENGAGE Learning.
3. Jean Paul Tremblay, P. G. Sorenson, "Introduction to Data Structure and Its Applications", McGraw-Hill Higher Education 2nd Edition.
4. Data Structures Using C, ISRD Group, 2ndEdition, Tata McGraw-Hill.

Reference books:

1. Data Structures using C, E Balagurusamy, 1st Edition, 2013, McGraw-Hill Education India.
2. Data Structures using C and C++, Rajesh K Shukla, 1st Edition, 2009, Wiley-India.
3. Data Structures Using C, Aaron M Tenenbaum, Yedidyah Langsam, Moshe J Augenstein, 1st Edition, 2019, Pearson Publication.

Online References:

1. https://nptel.ac.in/courses/106/102/106102064/
2. https://www.coursera.org/specializations/data-structures-algorithms
3. https://www.edx.org/course/data-structures-fundamentals
4. https://swayam.gov.in/nd1_noc19_cs67/preview

Course Assessment:

ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

MSE:

- To be conducted as written examination for 20 marks (on 40% - 50% syllabus)

End Semester Examination:

$ ESE of duration 03 hours are of 80 marks and scaled to 60.

1. Question paper will comprise of 03 questions.
2. Question1 (20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
3. Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
4. Question3 (20 marks):- Solve any 04 out of 06. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
AIMLC303	Discrete Structure and Graph Theory	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
AIMLC303	Discrete Structure and Graph Theory	20	20	60	--	--	100

Pre- requisite:

1. Basic Mathematics

Program Outcomes Addressed

1. PO1: Engineering Knowledge
2. PO2: Problem analysis
3. PO3: Design/development of solutions
4. PO4: Conduct investigation of complex problems

Course Objectives:

1. Cultivate clear thinking and creative problem solving.
2. Thoroughly train in the construction and understanding of mathematical proofs. Exercise common mathematical arguments and proof strategies.
3. To apply graph theory in solving practical problems.
4. Thoroughly prepare for the mathematical aspects of other Computer Engineering courses.

Course Outcomes: Learners will be able to

1. Illustrate the notion of mathematical thinking, mathematical proofs and to apply them in problem solving.
2. Interpret the concept of relations, functions, Diagraph .
3. Identify and analyze chain, antichain and lattice in hasse diagram
4. Analyze a complex computing problem and apply principles of discrete mathematics to identify solutions.
5. Identify the use of groups and codes in Encoding-Decoding.
6. Apply concepts of graph theory in solving real world problems.

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Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Logic**	**06**	
	1.1	Propositional Logic, Predicate Logic, Laws of Logic, Quantifiers, Normal Forms, Inference Theory of Predicate Calculus, Mathematical Induction.		**CO1**
		Self-learning Topics: Truth table, Boolean algebra.		
2.0		**Relations and Functions**	**06**	
	2.1	Basic concepts of Set Theory, sets, Venn diagram, operation on sets, partition of set.		**CO2**
	2.2	Relations: Definition, Types of Relations, Representation of Relations, Closures of Relations, Warshall's algorithm, Equivalence relations and Equivalence Classes.		
	2.3	Functions: Definition, Types of functions, Composition of functions, Identity and Inverse function.		
		Self-learning Topics: Operation on relations.		
3.0		**Posets and Lattice**	**05**	
	3.1	Partial Order Relations, Poset, Hasse Diagram, Chain and Anti chains, Lattice, Types of Lattice, Sub lattice.		**CO3**
		Self-learning Topics: Types of Partial order relations.		
4.0		**Permutation, Combination and Discrete Probability**	**08**	
	4.1	The rules of Sum and Product, Counting principles.		**CO4**
	4.2	Recurrence relations, Solving recurrence relations, Random experiment; sample space; events; axioms of probability; conditional probability. Theorem of total probability; Bayes' theorem. Application to information theory and discrete probability, Markov chains and their applications.		
		Self-learning Topics: Permutation and combinations		
5.0		**Algebraic Structures**	**08**	
	5.1	Algebraic structures with one binary operation: Semi group, Monoid, Groups, Subgroups, Abelian Group, Cyclic group, Isomorphism.		**CO5**
	5.2	Algebraic structures with two binary operations: Ring.		
	5.3	Coding Theory: Coding, binary information and error detection, decoding and error correction.		
		Self-learning Topics: Types of Rings, cryptography.		
6.0		**Graph Theory**	**06**	
	6.1	Types of graphs, Graph Representation, Sub graphs, Operations on		**CO6**

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		Graphs, Walk, Path, Circuit, Connected Graphs, Disconnected Graph, Components, Homomorphism and Isomorphism of Graphs, Euler and Hamiltonian Graphs, Planar Graph, Cut Set, Cut Vertex, graph coloring, graph travelers algorithm (BFS, DFS, Dijsktra's algorithm).		
		Self-learning Topics: Application of cut vertex and cut set vertex, application of graph theory.		
		Total	**39**	

Textbooks:

1. Bernad Kolman, Robert Busby, Sharon Cutler Ross, Nadeem-ur-Rehman, "Discrete Mathematical Structures", Edition 6, 2015, Pearson Education.
2. C. L. Liu "Elements of Discrete Mathematics", Fourth edition 2017, McGraw-Hill Book Company.
3. K. H. Rosen, "Discrete Mathematics and applications", Eight edition 2021, Tata McGraw Hill Publishing Company**.**

Reference books:

1. Y N Singh, "Discrete Mathematical Structures", First Edition 2016 Reprint, Wiley-India.
2. J. L. Mott, A. Kandel, T. P. Baker, "Discrete Mathematics for Computer Scientists and Mathematicians", Second Edition 1986, Prentice Hall of India.
3. J. P. Trembley, R. Manohar "Discrete Mathematical Structures with Applications to Computer Science", Seventeenth Edition 2002, Tata McGraw Hill Publishing Company.
4. Narsing Deo, "Graph Theory with applications to engineering and computer science", First Edition 2004, PHI Publications.

Online References:

1. https://www.edx.org/learn/discrete-mathematics
2. https://www.coursera.org/specializations/discrete-mathematics
3. https://nptel.ac.in/courses/106106094
4. https://swayam.gov.in/nd1_noc19_cs67/preview

Course Assessment:

ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

MSE:

- To be conducted as written examination for 20 marks (on 40% - 50% syllabus)

End Semester Examination:

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$ ESE of duration 03 hours are of 80 marks and scaled to 60.

1. Question paper will comprise of 03 questions.
2. Question1 (20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
3. Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
4. Question3 (20 marks):- Solve any 04 out of 06. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
AIMLC304	Database Management System	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE[$]			
		ISE	MSE				
AIMLC304	Database Management System	20	20	60	--	--	100

Pre- requisite:

1. FEC104 C- Programming

Program Outcomes Addressed

1. PO1: Engineering Knowledge
2. PO2: Problem analysis
3. PO3: Design/development of solutions
4. PO11: Lifelong learning

Course Objectives:

1. To understand the basics of database systems.
2. To develop an entity-relationship data model and its mapping to a relational model.
3. To learn relational algebra and formulate SQL queries.
4. To apply normalization techniques to normalize the database.
5. To understand the concept of transactions, concurrency control, and recovery techniques.
6. To learn and explore recent databases and their applications.

Course Outcomes: Learners will be able to

1. Identify the purpose of the database management system and its operational details.
2. Construct an ER/EER diagram, a relational model, and formulate relational algebra queries.
3. Apply SQL queries to the given database.
4. Apply normalization techniques for relational database design.
5. Illustrate the concepts of transaction management, concurrency control and database recovery.
6. Understand the fundamentals of recent databases and their uses.

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Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Introduction Database Concepts and Data modeling**	**08**	
	1.1	Introduction, Characteristics of databases, File system vs. Database system, Data abstraction and data Independence, DBMS system architecture, Applications of databases. The Entity-Relationship (ER) Model: Entity types: Weak and strong entity sets, entity sets, types of attributes, keys, and relationship constraints: Cardinality and Participation, Extended Entity-Relationship (EER) Model: Generalization, Specialization, and Aggregation.		**CO1**
		Self-learning Topics: Database storage structures		
2.0		**Relational Model and Relational Algebra**	**05**	
	2.1	Introduction to the Relational Model, relational schema. Mapping the ER and EER models to the relational model. Relational algebra - Operators and algebra queries.		**CO2**
		Self-learning Topics: Relational Calculus		
3.0		**Structured Query Language (SQL)**	**08**	
	3.1	Overview of SQL, Data Definition Commands, Integrity constraints: key constraints, Domain Constraints, Referential integrity, check Constraints Data Manipulation commands, Data Control commands, Set and string operations, aggregate function-group by, having, Views in SQL, joins, Nested and complex queries, Triggers.		**CO3**
		Self-learning Topics: Stored Procedures, Introduction to PL/SQL		
4.0		**Database Normalization**	**06**	
	4.1	Pitfalls in relational database designs, Concept of normalization, Function Dependencies, First Normal Form, 2NF, 3NF, BCNF, 4NF.		**CO4**
		Self-learning Topics: 5NF		
5.0		**Transactions Management, Concurrency Control and Recovery**	**08**	
	5.1	Transaction concept, Transaction states, ACID properties, Transaction Control Commands, Concurrent Executions, Serializability-Conflict and View, Concurrency Control: Lock-based, Timestamp-based protocols, Recovery System: Log-based recovery, Deadlock handling		**CO5**
		Self-learning Topics: Deadlock handling		
6.0		**Introduction to Emerging databases**	**04**	

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	6.1	Limitations of conventional databases, Multimedia databases: data types, contents of multimedia databases, Cloud databases: Introduction, Design Steps, Distributed databases: types, storage methods		**CO6**
		Self-learning Topics: Object-oriented database, NoSQL databases.		
		Total	**39**	

Textbooks:

1. Database System Concepts, Korth, Silberchatz, Sudarshan, 6th Edition, McGraw Hill, 2010.
2. Fundamentals of Database Systems, Elmasri and Navathe, 5th Edition, Pearson Education, 2006.
3. Database Management Systems, Raghu Ramakrishnan and Johannes Gehrke, 3rd Edition, TMH (McGraw-Hill), 2002.

Reference books:

1. Database Systems: Design, Implementation, and Management, Peter Rob and Carlos Coronel, 9th Edition, Thomson Learning, 2009.
2. SQL and PL/SQL for Oracle 10g, Black Book, Dr. P.S. Deshpande, Dream Tech Press, 2007.
3. Database Management Systems, G. K. Gupta, McGraw Hill, 2012.

Online References:

1. https://swayam.gov.in/nd1_noc19_cs46/preview
2. https://www.coursera.org/learn/database-design-postgresql
3. https://www.classcentral.com/course/swayam-database-management-system-9914
4. https://www.mooc-list.com/tags/dbms

Course Assessment:

ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

MSE:

- To be conducted as written examination for 20 marks (on 40% - 50% syllabus)

End Semester Examination:

$ ESE of duration 03 hours are of 80 marks and scaled to 60.

1. Question paper will comprise of 03 questions.
2. Question1 (20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
3. Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
4. Question3 (20 marks) :- Solve any 04 out of 06. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
AIMLC305	Computer Organization and Architecture	02	-	-	02	-	-	02

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE[$]			
		ISE	MSE				
AIMLC305	Computer Organization and Architecture	15	15	45	--	--	75

Pre-requisite:

1. FEC204 – Digital System Design

Program Outcomes Addressed:

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solutions
4. PO5: Modern Tool Usage
5. PO6: The Engineer and Society
6. PO11: Life-Long Learning

Course Objectives:

The course aims to provide students with:

1. A comprehensive understanding of computer architecture and organization, including functional units and number representations.
2. Knowledge of processor architecture, instruction formats, and control unit design.
3. Insights into memory hierarchy, virtual memory, and cache memory concepts.
4. An understanding of I/O organization, peripheral interfacing, and data transfer mechanisms.
5. Exposure to advanced processor principles, including parallel processing and multi-core architectures.
6. Practical problem-solving skills related to instruction execution, memory management, and system performance optimization.

Course Outcomes: Learners will be able to

Upon completion of this course, learners will be able to:

1. Describe the basic organization of a computer system, including functional units.
2. Apply data representation techniques and arithmetic algorithms for efficient computation and problem-solving in computer architecture.
3. Analyze processor architectures, instruction formats, addressing modes, arithmetic algorithms, and

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control unit design for efficient instruction execution.
4. Examine memory hierarchy, virtual memory management techniques, and cache organization for performance optimization.
5. Apply I/O interfacing concepts and peripheral device communication.
6. Differentiate advanced processor concepts, parallel processing, and system bus architectures.

Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Introduction**	**03**	
	1.1	Introduction to computer architecture and organization. Basic organization of computer. Block-level description of the functional units. **Self-learning Topics:** Performance measure of computer architecture, Amdahl's law		**CO1**
2.0		**Data Representation and Arithmetic Algorithms**	**03**	
	2.1	Booth's algorithm , Division of integers: Restoring and non-restoring division , Floating point representation: IEEE 754 floating point number representation. **Self-learning Topics:** Floating point arithmetic: Addition, Subtraction, Multiplication, Division, ALU and Shifters		**CO2**
3.0		**Processor Architecture and Organization**	**08**	
	3.1	Von Neumann model , Harvard architecture ,8086 architecture. Register Organization, instruction formats, addressing modes, instruction cycle Instruction interpretation and sequencing		**CO3**
	3.2	Hardwired control unit design methods: State table, Delay element , Microprogrammed control Unit: Microinstruction sequencing and execution. Micro operations , Examples of microprograms **Self-learning Topics:** Hardwired control unit design method: Sequence Counter		
4.0		**Memory Organization**	**06**	
	4.1	Memory hierarchy: Cost and performance measurement ,Virtual Memory: Concept, Segmentation and Paging, Address translation mechanism, Interleaved and Associative memory		**CO4**

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	4.2	Cache memory concepts , Locality of reference Design problems based on mapping techniques , Cache coherency, Write policies **Self-learning Topics:** Virtual memory in modern operating systems		
5.0		**I/O Organization and Peripherals**	**03**	
	5.1	Input/output systems, I/O module-need & functions , 8255-PPI block diagram, Operating modes		**CO5**
	5.2	Interfacing with 8086 **Self-learning Topics:** Direct Memory Access (DMA), Interrupt types		
6.0		**Advanced Processor Principles and Buses**	**03**	
	6.1	Introduction to parallel processing, Flynn's classification, Instruction pipelining, Introduction to Multi-core processor architecture		**CO6**
	6.2	Concept of superscalar architecture **Self-learning Topics:** Very Long Instruction Word (VLIW) processor, Pipeline hazards		
		Total	**26**	

Textbooks:

1. William Stallings, "Computer Organization and Architecture: Designing for Performance", Pearson Publication, 11th Edition, 2022.
2. John P. Hayes, "Computer Architecture and Organization", 3rd Edition, McGraw-Hill, 2017.
3. B. Govindarajulu, "Computer Architecture and Organization: Design Principles and Applications", Second Edition, McGraw-Hill (India), 2017.
4. John Uffenbeck, "8086/8088 family: Design Programming and Interfacing", PHI, 1986.
5. K. M. Bhurchandani and A. K. Ray, "Advanced Microprocessors and Peripherals", 3rd Edition, McGraw Hill, 2017.

Reference books:

1. Andrew S. Tanenbaum, "Structured Computer Organization", Pearson, Sixth Edition, 2016.
2. Morris Mano, "Computer System Architecture", 3rd Edition, Pearson Publication, 2017.
3. Kai Hwang, Fayé Alayé Briggs, "Computer architecture and parallel processing", McGraw Hill, 2017.

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4. P. Pal Chaudhuri, "Computer Organization and Design", 3rd Edition, Prentice Hall India, 2008.
5. Dr. M. Usha, T.S. Shrikant, "Computer System Architecture and Organization", Wiley India, 2019.
6. Douglas Hall, "Microprocessor and Interfacing", 3rd Edition, Tata McGraw Hill, 2017.

Online References:

1. https://onlinecourses.nptel.ac.in/noc21_cs61/preview
2. https://www.udemy.com/course/computer-organization-and-architecture-j/?couponCode=ST4MT240225A
3. https://www.coursera.org/learn/comparch
4. https://www.udemy.com/course/8086-microprocessor-architecture-programming/?couponCode=ST4MT240225A
5. https://onlinecourses.nptel.ac.in/noc21_ee41/preview

Course Assessment:

ISE: To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 10 marks and 5 marks attendance.

MSE: To be conducted as a written examination for 15 marks (on 50% syllabus)

End Semester Examination:

$ ESE duration of 02 hours is of 60 marks and scaled to 45

1. Question paper will comprise of 3 questions.
2. Question 1 (15 marks): - Solve any 03 out of 04. All questions carry 05 marks each.
3. Question 2 (30 marks): - Solve any 03 out of 05. All questions carry 10 marks each.
4. Question 3 (15 marks):- Solve any 03 out of 04. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
AIMLC306	Engineering Economics	02	-	-	02	-	-	02

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE[$]			
		ISE	MSE				
AIMLC306	Engineering Economics	50		--	--	--	50

Pre-requisite:

1. Principles of Basic Mathematics

Program Outcomes Addressed

1. PO1: Engineering Knowledge
2. PO2: Problem analysis
3. PO10: Project Management and Finance
4. PO11: Lifelong Learning.

Course Objectives:

1. To introduce students to the basic principles of economics and their application to engineering decision-making.
2. To Explore the Role of Trade in a Modern Economy
3. To develop student's analytical skills in assessing consumer behavior and the determinants of demand and supply across different market structures, including price elasticity.
4. To enable students to understand cost analysis, pricing, project evaluation.
5. To develop the ability to make informed decisions regarding engineering projects based on economic criteria.
6. To Understand the Concept of Interest Rates and Their Role in the Economy

Course Outcomes: Learners will be able to

1. Define the basic concepts of micro and macroeconomics, engineering economics and their application in engineering economics.
2. Define and Explain the Concept of Market in the Modern Economy.
3. Evaluate the effects of changes in demand and supply on price determination of products and services.
4. Analyze the costs and benefits of various engineering solutions.
5. Develop the ability to account for time value of money using engineering economy factors and formulas.
6. Understand market dynamics and pricing strategies in different industrial sectors

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Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Introduction to Economics**	**03**	
	1.1	**Economics** - Nature, Scope, Basic problems of an economy, Micro Economics and Macro Economics, The three problems of Economics Organization. Introduction to Engineering Economics.		**CO1**
		Self-Learning: Basic Economic Concepts: Cost, Benefit, Profit.		
2.0		**Market and Government in Modern Economy**	**03**	
	2.1	**Modern Economy** - Market Definition, How market solve three economics problems, Trade, Money & Capital, The economic role of Government.		**CO2**
		Self-Learning: Market Economy vs. Planned Economy, The Role of Private vs. Public Sectors		
3.0		**Supply, Demand and Product market**	**06**	
	3.1	**Basic Elements of Supply and Demand** - The determination of Demand and Supply, The Demand Schedule, The Supply Schedule, Equilibrium of supply and demand. Application of Supply and Demand.		**CO3**
	3.2	**Elasticity of Demand and Supply** - Price elasticity of Demand, Elasticity and Revenue, Price elasticity of Supply.		
	3.3	**Demand and Consumer behavior** - Choice and utility theory, Equimarginal principle, An alternative approach: substitution effect and income effect, From Individual to market demand.		
		Self-Learning: Case Study on demand and supply.		
4.0		**Production and Cost Theory**	**05**	
	4.1	**Production** - Production function, Laws of returns: Law of variable proportion, Law of returns to scale.		**CO4**
	4.2	**Cost and Revenue Concepts** - Total Costs, Fixed cost, Variable cost, Average cost and Marginal cost, The Link between production and costs, Analysis of cost minimization.		
		Self-Learning: Read case studies about businesses optimizing their production costs and making strategic production decisions.		
5.0		**Time value and Project evaluation with money**	**04**	
	5.1	**Time Value of Money** - Interest - Simple and compound, nominal and effective rate of interest, Cash flow diagrams, Principles of economic equivalence.		**CO5**

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	5.2	**Evaluation of Engineering Projects** -Present worth method, Future worth method, Annual worth method, Internal rate of return method.		
		Self-Learning: Learn to use financial calculators or Excel functions for quick calculations of TVM.		
6.0		**Money, Banking and Financial Markets**	**05**	
	6.1	**Money and Interest Rates -** The Evolution of Money, Functions of Money, Interest rates, Price of Money, Demand for money.		
	6.2	**Banking and the supply of money** - Banking definition, Types of Banks, Banking as as a business, The process of Deposits creations.		**CO6**
	6.3	**Financial Economics** - Financial assets, Risk and return on different assets, The stock market, Personal financial strategies.		
		Self learning: The evolution of financial market.		
		Total	**26**	

Textbooks:

1. Paul A. Samuelson and William D. Nordhaus, "Economics", Tata McGraw Hill, 20th edition, 2019.
2. L. Blank and A. Tarquin, *Engineering Economy*, 9th ed., McGraw-Hill, 2024.

Reference books:

1 J. V. O'Connor, Introduction to Engineering Economics, 5th ed., Pearson, 2013.
2 W S Jawadekar, "Management Information Systems," TMH, 6th edition, 2020.
3 C. S. Park, Fundamentals of Engineering Economics, 4th edition, Pearson, 2018.

Online References:

1. https://www.mheducation.com/highered/product/Engineering-Economy-Blank.html.
2. https://archive.org/details/engineeringecono0000blan_t5b6.
3. https://www.liberty.edu/online/courses/ENGI220.
4. https://online.stanford.edu/courses/cee146s-engineering-economics-and-sustainability.

ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 50 marks.
- ISE 50 marks = 10 marks for attendance + 40 marks for activities.

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
AIMLL301	Data Structure Lab	--	02	--	--	01	-	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
AIMLL301	Data Structure Lab	--	--	--	25	25	50

Pre-requisite:

1. FEL103- Knowledge of C programing

Program Outcomes Mapped:

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design and development of solutions
4. PO7: Ethics
5. PO11: Life-Long Learning

Lab Objectives:

1. To implement basic data structures such as arrays, linked lists, stacks and queues.
2. To Solve problem involving graphs, and trees.
3. To Select an appropriate data structure for the given problem.
4. To develop application using data structure algorithms.
5. To prepare students in analysing different searching and hashing techniques.
6. To prepare students in applying linear and non-linear data structures for real world problems solving.

Lab Outcomes:

Upon completion of this course, the learner will be able to:

1. Apply various linear data structures to perform operations like insertion, deletion, searching and traversing on them.
2. Apply various nonlinear data structures & be able to handle operations like insertion, deletion, searching and traversing on them
3. Choose appropriate data structure and apply it in various problems.
4. Select appropriate searching techniques for given problems.
5. Analyze different variations in linear data structures.
6. Analyze different variations in non-linear data structures.

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Suggested Experiments: Students are required to complete at least 10 experiments.		
Star (*) marked experiments are compulsory.		
Sr. No.	**Title of Experiments**	**LO**
1*	Implement Stack ADT using array.	LO1
2*	Convert an Infix expression to Postfix expression using stack ADT.	LO1
3*	Evaluate Postfix Expression using Stack ADT.	LO1, LO3
4	Applications of Stack ADT.	LO1, LO3
5*	Implement Linear Queue ADT using array.	LO1
6*	Implement Circular Queue ADT using array.	LO5
7	Implement Priority Queue ADT using array.	LO5
8	Implement Singly Linked List ADT.	LO2
9*	Implement Circular Linked List ADT.	LO5
10	Implement Doubly Linked List ADT.	LO5
11*	Implement Stack / Linear Queue ADT using Linked List.	LO1, LO2
12*	Implement Binary Search Tree ADT using Linked List.	LO2, LO6
13*	Implement Graph Traversal techniques a) Depth First Search b) Breadth First Search	LO2, LO6
14*	Applications of Binary Search Technique.	LO4
15	Quiz on lead code based on above expriments.	LO1-6

Text Books:

1. Data Structures using C, Reema Thareja, 2 nd Edition, 2014, Oxford Press.
2. Data Structures Using C, Aaron M Tenenbaum, Yedidyah Langsam, Moshe J Augenstein, 1 st Edition, 2019, Pearson Publication.
3. Data Structures: A Pseudocode Approach with C, Richard F. Gilberg and Behrouz A. Forouzan, 2nd Edition, 2007, CENGAGE Learning.
4. Jean Paul Tremblay, P. G. Sorenson, “Introduction to Data Structure and Its Applications”, McGraw-Hill Higher Education 2nd Edition
5. Data Structures Using C, ISRD Group, 2ndEdition, Tata McGraw-Hill

Reference Books:

1. Data Structures using C, E Balagurusamy, 1st Edition, 2013, McGraw-Hill Education India
2. Data Structures using C and C++, Rajesh K Shukla, 1st Edition, 2009, Wiley-India.

Online Resources:

1. www.leetcode.com
2. www.hackerrank.com
3. www.cs.usfca.edu/~galles/visualization/Algorithms.html
4. www.codechef.com

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Term Work:
Term work should consist of at least 10 experiments.
Journal must include at least 2 assignments.

The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. The assignments should be students' centric and an attempt should be made to make assignments more meaningful, interesting and innovative. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks (CIAP):

25 Marks (Total Marks) =15 Marks (Experiment) + 05 Marks (Assignments) + 05 Marks

(Attendance)

The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.

Practical Exam: (2 hours/ 25 Marks)
End-semester Practical and oral exam will be held based on the above syllabus and will be conducted as End Semester Examination Practical (ESEP).

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
AIMLL302	Database Management System Lab	--	02	--	--	01	-	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
AIMLL302	Database Management System Lab	--	--	--	25	25	50

Pre-requisite:

1. FEC104 C- Programming

Program Outcomes addressed :

1. PO2: Problem analysis
2. PO3: Design / Development of Solutions.
3. PO5: Engineering Tool Usage
4. PO7: Ethics
5. PO8: Individual and Collaborative Team Work
6. PO9: Communication
7. PO11: Life-Long learning

Lab Objectives:

1. To explore the design and development of a relational model.
2. To write SQL basic and complex queries.
3. To learn transaction processing and concurrent data access.

Lab Outcomes:

Upon completion of the course, Learners will be able to:

1. Design an ER/EER diagram and convert it to a relational model for the real-world application.
2. Apply DDL, DML, DCL, and TCL commands.
3. Implement simple and complex queries.
4. Implement triggers and procedures.
5. Demonstrate the concept of concurrent transaction execution.
6. Illustrate the front-end-backend connectivity.

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Suggested List of Experiments:		**LO Mapped**
Sr. No.	**Title of Experiments**	
1	Identify the case study and detail the statement of the problem. Design an entity-relationship (ER) / extended entity-relationship model.(Use Lucidchart/Draw. Io/UML tool)	LO 1
2	Mapping ER/EER to a relational schema model.	LO 1
3	Design a database using Data Definition Language (DDL) and apply integrity constraints for the specified system.	LO 2
4	Apply DML commands for the specified system.	LO 2
5	Implement Simple queries, string manipulation operations, and aggregate functions.	LO 3
6	Implement various join operations.	LO 3
7	Implement Nested and Complex queries.	LO 3
8	Implement DCL and TCL commands.	LO 2
9	Implement procedures and functions.	LO 4
10	Implementation of views and triggers.	LO 4
11	Implementation and demonstration of transaction and concurrency control techniques using locks.	LO 5
12	Demonstrate database connectivity.	LO 6
13	Implementation of Graph Query Language	LO3

Text Books:

1. Database System Concepts, Korth, Silberchatz, Sudarshan, 6th Edition, McGraw Hill, 2010.
2. Fundamentals of Database Systems, Elmasri and Navathe, 5th Edition, Pearson Education, 2006.
3. Database Management Systems, Raghu Ramakrishnan and Johannes Gehrke, 3rd Edition, TMH (McGraw-Hill), 2002

Reference Books:

1. Database Systems: Design, Implementation, and Management, Peter Rob and Carlos Coronel, 5th Edition, Thomson Learning, 2002.
2. SQL and PL/SQL for Oracle 10g, Black Book, Dr. P.S. Deshpande, Dream Tech Press, 2007.
3. Database Management Systems, G. K. Gupta, McGraw Hill, 2012.

Online References:

Useful Links:

1. https://www.w3schools.com/sql/
2. https://www.tutorialspoint.com/sql/index.htm
3. https://learn.microsoft.com/en-us/sql/?view=sql-server-ver16

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Term Work:
The term work should include 10 experiments: At least 02 assignments covering the entire syllabus must be given on the content of theory and practicals of "Database Management System". The assignments should be student' centric and an attempt should be made to make assignments more meaningful, interesting, and innovative. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks:
25 Marks (Total Marks) = 15 Marks (Experiment) + 05 Marks (Assignments) + 05 Marks (Attendance)
The final certification and acceptance of term work ensure satisfactory performance of laboratory work and minimum passing marks in term work.

Practical Exam: (2 hours/ 25 Marks)
End-semester practical and oral exams will be held based on the above syllabus and will be conducted as End-Semester Examination Practical (ESEP).

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
AIMLL303	Computer Organization and Architecture Lab	--	02	--	--	01	-	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
AIMLL303	Computer Organization and Architecture Lab	--	--	--	25		25

Pre-requisite:

1. FEL203 -Digital System Design Lab

Program Outcomes Addressed:

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solutions
4. PO5: Modern Tool Usage
5. PO11: Life-Long Learning

Lab Objectives:

The course aims to equip students with the ability to:

1. Understand fundamental arithmetic algorithms, including Booth's algorithm and division algorithms, through implementation.
2. Develop skills in designing and simulating ALU, memory, and cache memory using appropriate simulation tools.
3. Apply assembly programming concepts for arithmetic operations, data transfer, and code conversions using 8086 programming tools (Debug/TASM/MASM/8086kit).
4. Demonstrate proficiency in array manipulation techniques such as sorting, finding the minimum/maximum value, and computing GCD/LCM using 8086 assembly language.
5. Perform data transfer operations and control unit functionalities using 8086 assembly programming.
6. Interface peripheral devices like 8255 for read/write operations and waveform generation.

Lab Outcomes:

Upon completion of this course, learners will be able to:

1. Apply Booth's multiplication algorithm and restoring/non-restoring division algorithms using assembly language.
2. Design and simulate ALU, memory, and cache memory structures using a simulator.
3. Solve arithmetic operations on 8-bit and 16-bit data using assembly programming tools.

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4. Develop assembly programs for code conversion (Hex-BCD, ASCII-BCD), data transfer, and factorial calculation using 8086.
5. Apply array-based algorithms, such as sorting and finding the GCD, LCM, minimum, and maximum values using 8086 assembly language.
6. Illustrate interfacing of 8255 PPI with 8086 to perform read/write operations and square wave generation.

Suggested List of Experiments:		**LO Mapped**
Sr. No.	**Title of Experiments**	
1	To implement Booth's algorithm.	LO1
2	To implement restoring division algorithm.	LO1
3	To implement non restoring division algorithm.	LO1
4	To implement ALU design using simulator.	LO2
5	To implement memory design using simulator.	LO2
6	To implement cache memory design using simulator.	LO2
7	Use of programming tools (8086kit/ Emulator 8086) to perform basic arithmetic operations on 8-bit data.	LO3
8	Use of programming tools (8086kit/ Emulator 8086) to perform basic arithmetic operations on 16-bit data.	LO3
9	Code conversion (Hex to BCD and BCD to Hex)/ (ASCII to BCD and BCD to ASCII) using 8086.	LO4
10	To transfer a block of data using 8086.	LO4
11	Assembly program to find the GCD/ LCM of two numbers.	LO4
12	Assembly program to sort numbers in ascending/ descending order.	LO5
13	Assembly program to find minimum/ maximum number from a given array.	LO5
14	Calculate the factorial of a given number using 8086.	LO4
15	Program for interfacing 8355 for Read/Write operation/ Square wave generation.	LO6

Textbooks:

1. William Stallings, "Computer Organization and Architecture: Designing for Performance", Pearson Publication, 10th Edition, 2013.
2. John P. Hayes, "Computer Architecture and Organization", McGraw-Hill, 1988.
3. B. Govindarajulu, "Computer Architecture and Organization: Design Principles and Applications", Second Edition, McGraw-Hill (India).
4. John Uffenbeck, "8086/8088 family: Design Programming and Interfacing", PHI.
5. K. M. Bhurchandani and A. K. Ray, "Advanced Microprocessors and Peripherals", McGraw Hill

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Reference books:

1. Andrew S. Tanenbaum "Structured Computer Organization", Pearson, Sixth Edition.
2. Morris Mano. "Computer System Architecture" Pearson Publication, 3rd Edition, 2007.
3. Kai Hwang, Fayé Alayé Briggs. "Computer architecture and parallel processing", McGraw Hill.
4. P. Pal Chaudhuri. "Computer Organization and Design" Prentice Hall India, 2004.
5. Dr. M. Usha, T.S. Shrikant. "Computer System Architecture and Organization" Wiley India, 2014.
6. Douglas Hall, "Microprocessor and Interfacing", Tata McGraw Hill.

Online Resources:

1. http://vlabs.iitkgp.ernet.in/coa/#
2. https://emu8086-microprocessor-emulator.en.softonic.com/

Term Work:

The term work shall include a total of **10 experiments**. Students must perform **any five experiments** from experiment numbers **1 to 6** and **any four experiments** from experiment numbers **7 to 14**. Additionally, **experiment 15 is compulsory** for all.

At least 02 assignments covering the entire syllabus must be given on the content of theory and practicals of "Computer Organization and Architecture". The assignments should be students' centric and an attempt should be made to make assignments more meaningful, interesting and innovative. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks:

- 25 Marks (Total Marks) =15 Marks (Experiment) + 05 Marks (Assignments) + 05 Mark (Attendance).
- The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
AIMLL304	Skill Lab (Python Programming)	--	2*+2	--	--	02	-	02

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
AIMLL304	Skill Lab (Python Programming)	--	--	--	25	25	50

Pre-requisite:

Programming Languages

1. FEC104: C – Programming
2. FEL205: Object Oriented Programming Methodology Lab -

Program Outcomes Addressed:

1. PO1: Engineering knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solutions
4. PO4: Conduct investigations of complex problems
5. PO5: Engineering Tool Usage
6. PO6: The Engineer & The World
7. PO7: Ethics
8. PO8: Individual & Collaborative Team work
9. PO9: Communication
10. PO10: Project Management & Finance
11. PO11: Life-Long learning

Lab Objectives:

1. To provide a comprehensive understanding of Python programming, covering both fundamental and advanced concepts.
2. To solve real-world applications using Data Structure and Multi-threading concept.
3. To introduce OOP principles for efficient coding practices.
4. To enhance knowledge of data analysis and visualization.
5. To prepare students for building Python-based applications involving GUI with database connectivity and networking.
6. To prepare students for analysing and visualizing real time data.

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Lab Outcomes:
Upon completion of course, learners will be able to:

1. Apply Python fundamentals, including data types, operators, and control structures to develop simple program.
2. Illustrate OOP concepts, files handling, directories, and text processing operations using Python.
3. Analyze different types of data structures such as linked lists, stacks, queues, and dequeues to solve computational problems effectively.
4. Apply multithreading concepts using Python for efficient concurrent execution.
5. Apply skills in integrating Python with GUI applications, networking, and database systems.
6. Apply data analysis and visualization techniques using tools like Pandas, NumPy, Matplotlib, and Seaborn

0		Knowledge of some programming language like C, Java.	**01**	**LO**
1		**Python basics**	**06**	**LO1**
	1.1	Introduction, Features, Python Identifiers, Keywords, Variables and Comments Indention, Operators in python, Input and print functions.		
	1.2	Control flow statement- Conditional statements (if, if…else, nested if), Looping in Python (while loop, for loop, nested loops), Loop manipulation using continue, pass, break.		
	1.3	Data Types in python: Number, Arrays in python, String and Character in python, Functions, Data Structures - List and Tuples, Dictionaries, Sets.		
	1.4	Functions- Types, parameters, arguments: positional arguments, keyword arguments, parameters with default values, functions with arbitrary arguments, Recursion, Scope of variables- Local and global scope, anonymous functions.		
		Self-study topics: Iterators and Generators		
2		**Advanced Python- OOP, File Handling and Exception Handling**	**05**	**LO2**
	2.1	Introduction to OOP – Classes and Objects: Creating Classes, Creating Instance Objects, Access Modifiers, Inheritance, Polymorphism, Operator Overloading, Abstract Classes, Overriding Methods.		
	2.2	Files in Python, Directories, Building Modules, Packages, Text Processing, Regular expression in python.		
	2.3	Exception handling: Compile time errors, Runtime errors, exceptions, types of exception, try statement, except block, raise statement, User - Defined Exceptions.		
		Self-study topics: Experiment to **Build a Personal Notes App (File-Based Storage), Automate Daily Tasks with Python.**		
3		**Data Structure in Python**	**02**	**LO3**
	3.1	Linked List, Stack, Queue, Dequeue.		

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		Self-study topics: polynomial representation and operations using linked list, Task Queues in Web Servers.		
4		**Python Integration Primer**		
	4.1	Graphical User interface, Python database connectivity, Introduction to APIs: Fetching Data from Web Services. Django web application Framework.	**04**	**LO4**
		Self-study topics: Fetch weather data from a public API and display it.		
5		**Multithreading**	**03**	
	5.1	Thread and Process, starting a thread, threading module, Synchronizing threads.		**LO5**
	5.2	Socket Programming.		
		Self-study topics: Multithreaded Priority Queue.		
6		**Data Analysis and Visualization libraries**	**06**	**LO6**
	6.1	NumPy - Creating NumPy arrays, Indexing and slicing in NumPy, Dimensions of Arrays, Attribute of array, manipulating array shapes, working with multi-dimensional arrays, Indexing and slicing in multi-dimensional arrays, Matrices in NumPy, Mathematical Functions of NumPy.		
	6.2	Pandas - Creating Data Frame from an Excel Spreadsheet, .csv File, Python Dictionary and Python List of Tuples, Operations on Data Frames, Series and Data Frames.		
	6.3	Matplotlib, Seaborn - Introduction to Matplotlib library, Line properties, Plots and subplots, Types of Plots, Introduction to Seaborn. Bar Graph, Histogram, Pie Chart,Line Graph.		
		Self-study topics: Creating array views copies, Aggregating, Merge Data Frames, Interactive Visualization with Plotly.		
			26	

Textbooks:

1. Dr. R. Nageswara Rao, “Core Python Programming”, Dreamtech Press,2021.
2. James Payne, “Beginning Python: Using Python 2.6 and Python 3.1”, Wrox Publication, 2011.
3. Anurag Gupta, G. P. Biswas, “Python Programming”, McGraw-Hill, 2019
4. E. Balagurusamy, “Introduction to computing and problem-solving using Python,” McGraw Hill Education, 2017.

Reference Books:

1. Zed A. Shaw, “Learn Python the Hard Way", Addison-Wesley Professional 2024.
2. Laura Cassell, Alan Gauld, “Python Projects”, Wrox Publication, 2015.

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Software Tools:

1. Python IDLE
2. PyCharm,
3. **Visual Studio Code (VS Code)**
4. Jupyter Notebook
5. Google Colab
6. Notepad++

Online Repository:

1. Google Drive
2. GitHub
3. Code Guru

Online Resources:

1. https://docs.python.org/release/3.0.1/tutorial/
2. https://www.perl.org/books/beginning-perl/
3. https://spoken-tutorial.org/
4. https://starcertification.org/Certifications/Certificate/python
5. https://onlinecourses.nptel.ac.in/noc22_cs32/preview

Suggested List of Programming Assignments/laboratory Work:		**LO**
Sr. No.	**Name of the Experiment**	
1	Exploring basics of python like data types (strings, list, array, dictionaries, set, tuples) and control statements.	LO1
2	Creating functions, classes and objects using python. Demonstrate exception handling and inheritance.	LO1, LO2
3	Exploring Files and directories a. Python program to append data to existing file and then display the entire file b. Python program to count number of lines, words and characters in a file. c. Python program to display file available in current directory	LO2
4	Menu driven program for data structure using built in function for linked list, stack and queue.	LO3
5	a. Creating GUI with python containing widgets such as labels, textbox, radio, checkboxes and custom dialog boxes. b. Program to demonstrate CRUD (**create, read, update and delete)** operations on database (SQLite/ MySQL) using python.	LO4
6	To learn how to make API requests in Python using the requests module and fetch data from a public web service.	LO4
7	Programs on Threading using python.	LO5
8	To implement client server communication using socket programming	LO5
9	To explore the basics of NumPy methods and demonstrate the use of NumPy array objects for performing efficient numerical computations, including array creation, operations, and manipulations.	LO6

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10	To explore and understand the functionalities of **Pandas Series and Data Frames**, including their creation, manipulation, and grouping using the groupby () function in Python.	LO6
11	Program to demonstrate Data Series and Data Frames using Pandas.	LO6
12	Graphical representation and analysis of the data using python to analyze and visualize a given dataset using Python by applying various graphical techniques.	LO6
13*	Program to send email and read content of URL.	LO5

Term Work

1 Term work should consist of 12 experiments and performance of 13th Experiment is optional
2 Journal must include at least 02 assignments
3 Mini Project based on the content of the syllabus (Group of maximum 2-3 students)
4 The final certification and acceptance of term work ensures that satisfactory performance oflaboratory work and minimum passing marks in term work.
5 Total 25-Marks (Experiments: 10-marks, Assignment: 05-marks, Attendance: 05-marks,Mini Project: -5-marks)
6 The assignments should be students' centric and an attempt should be made to make assignments more meaningful, interesting and innovative. Term work will be assessed as Continuous Internal Assessment Practical (CIAP)

Oral & Practical exam

Based on the entire syllabus of **AIMLL304: Skill Lab (Python Programming)** will be conducted as End Semester Examination Practical (ESEP).
The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
AIMLM301	Mini Project 1 A	--	02#	--	--	01	-	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
AIMLM301	Mini Project 1 A	--	--	--	25	25	50

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solutions
4. PO4: Conduct investigations of complex problems
5. PO5: Engineering Tool Usage
6. PO6: The Engineer & The World
7. PO7: Ethics
8. PO8: Individual & Collaborative Team work
9. PO9: Communication
10. PO10: Project Management & Finance
11. PO11: Life-Long learning

Objectives:

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Outcome: Upon completion of this course, learners will be able to…

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as a member of a group or leader.
4. Deduce the proper inferences from available results through theoretical/ experimental /simulations.
5. Analyze the impact of solutions in societal and environmental context for sustainable development.
6. Apply standard norms of engineering practices.
7. Develop skills in written and oral communication.

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8. Illustrate capabilities of self-learning in a group, which leads to life long learning.
9. Explain project management principles during project work.

Guidelines for Mini Project

1. Students shall form a group of 3 to 4 students, while forming a group shall not be allowed for less than three or more than four students, as it is a group activity.
2. Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
3. Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
4. A logbook to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
5. Faculty supervisors may give input to students during mini project activity; however, focus shall be on self-learning.
6. Students in a group should understand problems effectively, propose multiple solutions and select best possible solution in consultation with guide/ supervisor.
7. Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
8. The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
9. With the focus on self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
10. However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case-by-case basis.

Guidelines for Assessment of Mini Project: Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below.
  1. Marks awarded by guide/supervisor based on logbook: 10
  2. Marks awarded by review committee 10
  3. Quality of Project report 05

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The review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- In the first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on the presentation given by the students' group.
  - First shall be for finalization of problem
  - Second shall be on finalization of proposed solution of problem.
- In the second semester the expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
  - The first review is based on the readiness of building a working prototype to be conducted.
  - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
  - Identification of need/problem
  - Proposed final solution
  - Procurement of components/systems
  - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
  - First shall be for finalization of problem and proposed solution
  - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project

Mini Project shall be assessed based on the following criteria;

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact
7. Innovativeness
8. Cost effectiveness and Societal impact
9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individual's as member or leader
13. Clarity in written and oral communication

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- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
- In the case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- The report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organization's having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on the following points.

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
AIMLC401	Applied Mathematics-IV	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
AIMLC401	Applied Mathematics-IV	20	20	60	--	--	100

Pre-requisite: Knowledge of
1. FEC101- Applied Mathematics-I
2. FEC102- Applied Mathematics-II
3. AIMLC301- Applied Mathematics-III

Program Outcomes addressed:
1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/ development of solution
4. PO4: Conduct investigation of complex problems

Course Objectives:
1. To evaluate eigenvalues and eigenvectors and apply them to solve systems of linear equations and matrix diagonalization.
2. To evaluate line and contour integrals and construct the power series expansion of a complex-valued function.
3. To understand the concepts of probability distributions and sampling theory for small samples.
4. To apply the sampling theory on small dataset for analysis.
5. To understand the concepts of non-parametric and analysis of variance for testing.
6. To optimize the Linear and Non-linear programming problems.

Course Outcomes: Learners will be able to
1. Evaluate eigenvalues and eigenvectors, analyze their properties, and apply them in engineering problem-solving.
2. Apply the concepts of Complex Integration to evaluate integrals, analyze and compute residues, and solve various contour integrals.
3. Design conclusions on population-based data science problems and interpret the hypotheses.
4. Analyze nonparametric test and perform Analysis of Variance on the population to analyze data.

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5. Apply the concept of optimization on Linear Programming Problems.
6. Examine Non-Linear Programming Problems to engineering problems of optimization.

Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Linear Algebra (Theory of Matrices)**	**06**	
	1.1	Characteristic Equation, Eigenvalues and Eigenvectors, and properties (without proof). Cayley-Hamilton Theorem (without proof), verification and reduction of higher degree polynomials.		**CO1**
	1.2	Similarity of matrices, diagonalizable and non-diagonalizable matrices.		
	1.3	Functions of Square Matrix, Derogatory and non-derogatory matrices.		
		Self-Learning: Coding and encoding of matrices.		
2.0		**Complex Integration**	**07**	
	2.1	Line Integral, Cauchy's Integral theorem for simple connected and multiply connected regions (without proof), Cauchy's Integral formula (without proof).		**CO2**
	2.2	Taylor's and Laurent's series (without proof).		
	2.3	Definition of Singularity, Zeroes, poles of f(z), Residues, Cauchy's Residue Theorem (without proof).		
		Self-Learning: Application of Residue Theorem to evaluate real integrations		
3.0		**Probability Distribution and Sampling Theory**	**07**	
	3.1	Probability Distribution: Poisson and Normal distribution.		**CO3**
	3.2	Sampling distribution, Testing of Hypothesis, Level of Significance, Critical region, One-tailed, and two-tailed test, Degree of freedom.		
	3.3	Large Sampling with test of single mean and difference of means.		
	3.4	Students' t-distribution (Small sample). Test the significance of mean and Difference between the means of two samples.		
		Self-Learning: Large sampling with testing for parameters.		
4.0		**Test of Hypothesis- Chi square Distribution and ANOVA**	**07**	
	4.1	Chi-Square Test: Test of goodness of fit.		CO**4**
	4.2	Independence of attributes, Contingency table.		
	4.3	Analysis of Variance (F-Test): One way classification, Two-way classification (short-cut method).		
		Self-Learning: Other types of non-parametric tests.		
5.0		**Linear Programming Problems**	**06**	
	5.1	Types of solutions, Standard and Canonical of LPP, Basic and Feasible solutions, slack variables, surplus variables, Simplex method.		**CO5**
	5.2	Artificial variables, Big-M method (Method of penalty).		
	5.3	Dual Simplex Method.		

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		Self-Learning: Principle of Duality, Dual of LPP.		
6.0		**Nonlinear Programming Problems**	**06**	
	6.1	NLPP with one equality constraint (two or three variables) using the method of Lagrange's multipliers.		**CO6**
	6.2	NLPP with **One** inequality constraint: Kuhn-Tucker conditions.		
	6.3	NLPP with two inequality constraint: Kuhn-Tucker conditions.		
		Self-Learning: NLPP with two equality constraints.		
		Total	**39**	

Textbooks:

1. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication, 45th edition.
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited, 10th Edition 2023-24.
3. Higher Engineering Mathematics: B V Ramna; Tata McGraw Hill Publication
4. Fundamentals of Mathematical Statistics – S. C. Gupta & V. K. Kapoor, 12th edition, 2020.

Reference books:

1. **Matrices** – Shanti Narayan, S. Chand Publications, Revised edition.
2. Foundations of Complex Analysis, S. Ponnusamy, Narosa Publications.
3. **Advanced Engineering Mathematics** – H. K. Dass, S. Chand Publications, 2007.
4. J. K. Sharma, "Operation Research", S. Chand Publications, 6th edition 2017.
5. T. Veerarjan, "Engineering Mathematics", Tata McGraw Hill Publication 2007.

Online References:

Course on Advanced Engineering Mathematics

- https://nptel.ac.in/courses
- https://www.coursera.org/courses?query=advanced%20engineering%20mathematics

Course Assessment:

ISE: To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 15 marks and 5 marks attendance.

MSE: To be conducted as written examination for 20 marks (on 50% syllabus)

End Semester Examination

$ ESE duration of 03 hours and 80 marks and to be scaled down to 60

1. The question paper will comprise of 03 questions.
2. Question1 (20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
3. Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
4. Question3 (20 marks):- Solve any 04 out of 06. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
AIMLC402	Operating System	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
AIMLC402	Operating System	20	20	60	--	--	100

Pre-requisite:

1. AIMLC305- Computer Organization and Architecture

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis

Course Objectives:

1. To understand the basic concepts of Operating System, its functions and services.
2. To introduce the concept of a process and its management like transition, scheduling, etc
3. To understand basic concepts related to Inter-process Communication (IPC) like mutual exclusion, deadlock, etc. and role of an Operating System in IPC.
4. To understand the concepts and implementation of memory management policies and virtual memory.
5. To understand the functions of Operating System for storage management and device management.
6. To study the need and fundamentals of special-purpose operating system with the advent of new emerging technologies.

Course Outcomes: Learners will be able to ..

1. Identify the importance of operating system, its functions and services.
2. Compare process scheduling algorithms to ensure efficient execution of processes.
3. Apply concept of process synchronization and deadlocks.
4. Analyse memory management algorithms in effective allocation of main memory usage.
5. Discuss various File management methods and analyse I/O management algorithms for performance and quality criterion.
6. Compare the functions of various special-purpose Operating Systems.

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Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Operating system Overview**	**03**	
	1.1	Introduction, Objectives, Functions and Evolution of Operating System		**CO1**
	1.2	Operating system structures: Layered, Monolithic and Microkernel		
	1.3	Linux Kernel, Shell and System Calls		
		Self-Learning Topics: Resource Manager view, process view, Virtual Machine.		
2.0		**Process Management and Scheduling**	**07**	
	2.1	**Process:** Basic Concepts of Process; Process State Model and Transition; Operation on Process; Process Control Block, Context switching		**CO2**
	2.2	**Threads:** Introduction to Threads; Types of Threads		
	2.3	**Uniprocessor Scheduling:** Basic Concepts of Scheduling; Types of Schedulers scheduling algorithms.		
		Self-Learning Topics: Multithreading Models, Thread libraries, Performance comparison of Scheduling Algorithms		
3.0		**Process Synchronization and Deadlock**	**10**	
	3.1	**Process Synchronization:** Basic Concepts of Inter-process Communication and Synchronization; Race Condition; Critical Region and Problem; Peterson's Solution; Synchronization Hardware and Semaphores; Classic Problems of Synchronization; Message Passing		**CO3**
	3.2	**Deadlocks Management**: System Model, Deadlock Characterization; Deadlock Detection and Recovery; Deadlock Prevention; Deadlock Avoidance.		
		Self-Learning Topics: Barber's shop problem , real time case study for Deadlock detection and recovery		
4.0		**Memory Management**	**09**	
	4.1	**Memory Management:** Basic Concepts of Memory Management; Swapping; Contiguous Memory Allocation; Paging; Structure of Page Table; Segmentation.		**CO4**
	4.2	**Virtual Memory:** Basic Concepts of Virtual Memory; Demand Paging, Copy-on Write; Page Replacement Algorithms; Thrashing		
		Self-Learning Topics: Concept of memory management in Linux & Windows NT/XP		
5.0		**File and I/O Management**	**06**	

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	5.1	**File Management:** Basic Concepts of File System; File Access Methods; Directory Structure; File-System Implementation; Allocation Methods; Free Space Management; Overview of Mass- Storage Structure		**CO5**
	5.2	**I/O Management:** I/O devices, Organization of the I/O Function, Disk Organization, I/O Management and Disk Scheduling: FCFS, SSTF, SCAN, CSCAN, LOOK, C-LOOK.		
		Self-Learning Topics: NTFS File system, RAID structure		
6.0		**Operating Systems Security**	**04**	
	6.1	**Overview of Security and Protection:** Goals of Security and Protection, Security and Protection Threats.		**CO6**
	6.2	**Protection Structure:** Granularity of Protection, Access control Matrix, Access Control Lists (ACLs), Capability Lists(C-Lists), Protection Domain		
		Self-learning Topics: Classification of Computer Security, Security Attcks.		
		Total	**39**	

Textbooks:

1. A. Silberschatz, P. Galvin, G. Gagne, Operating System Concepts, 10th ed., Wiley, 2018.
2. W. Stallings, Operating Systems: Internal and Design Principles, 9th ed., Pearson, 2018.
3. A. Tanenbaum, Modern Operating Systems, Pearson, 4th ed., 2015.
4. D.M Dhamdhere, Operating Systems: A Concept Based Approach, Mc-Graw Hill, 2009.

Reference books:

1. Achyut Godbole and Atul Kahate, Operating Systems, McGraw Hill Education, 3rdEdition, 2011.
2. N. Chauhan, Principles of Operating Systems, 1st ed., Oxford University Press, 2014.
3. A. Tanenbaum and A. Woodhull, Operating System Design and Implementation, 3rd ed., Pearson, 2006.
4. R. Arpaci-Dusseau and A. Arpaci-Dusseau, Operating Systems: Three Easy Pieces, CreateSpace Independent Publishing Platform, 1st ed., 2018.

Online References:

1. https://www.nptel.ac.in
2. https://archive.nptel.ac.in/courses/106/105/106105214/
3. https://archive.nptel.ac.in/courses/106/105/106105172/

Course Assessment:

ISE: To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.

MSE: To be conducted as a written examination for 20 marks (on 40% - 50% syllabus).

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End Semester Examination

$ ESE of duration 3 hours are of 80 marks and scaled to 60.

1. Question paper will comprise of 03 questions.
2. Question1 (20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
3. Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
4. Question3 (20 marks) :- Solve any 04 out of 06. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
AIMLC403	Analysis of Algorithm	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
AIMLC403	Analysis of Algorithm	20	20	60	--	--	100

Pre-requisite:

1. FEC104: C-Programming
2. AIMLC302: Data Structure

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO4: Conduct investigations of complex problems
4. PO9: Individual and Collabrative team work
5. PO10: Communication
6. PO12: Life-Long learning

Course Objectives:

1. To provide mathematical approaches for analysis of algorithms.
2. To understand and solve problems using various algorithmic approaches.
3. To analyze algorithms using various methods.
4. To develop a technique for analyzing and computing the performance of an algorithm.
5. To understand computational complexity classes and their significance in problem-solving.
6. To apply algorithmic techniques to solve real-world computational problems

Course Outcomes:

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

1. Analyze the running time and space complexity of the algorithms.
2. Describe, apply, and analyze the complexity of the divide and conquer strategy.
3. Solve optimization problems using greedy strategy and analyze the complexity.
4. Illustrate and analyze the complexity of dynamic programming strategy.
5. Explain and apply backtracking, branch, and bound.
6. Apply string matching techniques and understand various complexity classes.

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Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Introduction**	**07**	
	1.1	**Introduction:** Performance analysis, space and time complexity, Growth of function, Big-Oh, Omega Theta notation Mathematical background for algorithm analysis. Analysis of selection sort, insertion sort.		**CO1**
	1.2	**Recurrences:** The substitution method, Recursion tree method, Master method.		
		Self-Learning: Bubble Sort, Randomized Algorithms		
2.0		**Divide and Conquer Approach**	**06**	
	2.1	General method, Merge sort, Quick sort, Finding minimum and maximum algorithms and their Analysis, Analysis of Binary search		**CO2**
		Self-Learning: Implementation of Linear search, Strassen's Matrix Multiplication		
3.0		**Greedy Method Approach**	**06**	
	3.1	General Method, Single source shortest path: Dijkstra Algorithm, Fractional Knapsack problem, Job sequencing with deadlines, Minimum cost spanning trees: Kruskal and Prim's algorithms		**CO3**
		Self-Learning: Graph representations: adjacency matrix and adjacency list, Optimal storage on tape algorithm.		
4.0		**Dynamic Programming Approach**	**09**	
	4.1	General Method, Multistage graphs, Single source shortest path Bellman ford Algorithm, All pair shortest path: Floyd Warshall Algorithm, 0/1 knapsack Problem, Travelling Salespersonproblem, longest common subsequence		**CO4**
		Self-Learning: Matrix operations, Assembly-line scheduling Problem		
5.0		**Backtracking and Branch and bound**	**06**	
	5.1	General Method, Backtracking: N-queen problem, Sum of subsets, Graph coloring.		**CO5**
	5.2	Branch and Bound: Travelling Salesperson Problem, 15 Puzzle problem		
		Self-Learning: Basics of graph theory and set theory, Hamiltonian cycle.		
6.0		**String Matching Algorithms**	**05**	
	6.1	The Naïve string-matching algorithm, The Rabin Karp algorithm, The Knuth-Morris-Pratt algorithm		**CO6**
	6.2	**Complexity class:** Definition of P, NP, NP-Hard, NP-Complete		
		Self-Learning: Modular arithmetic, Boyer Moore algorithm		
		Total	**39**	

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Textbooks:

1. Introduction to Algorithms by T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein was published by PHI Publication in 2005
2. Fundamentals of Computer Algorithms by Ellis Horowitz,Sartaj Sahni, and Sanguthevar Rajasekaran is the second edition, published by Orient BlackSwan in 2008.

Reference books:

1. Algorithms by Sanjoy Dasgupta,Christos Papadimitriou, and Umesh Vazirani was published by McGraw-Hill Education in 2006.
2. Design Methods and Analysis of Algorithms by S. K. Basu was published by PHI Learning Pvt. Ltd. in 2005.

Online References:

1. https://nptel.ac.in/courses/106/106/106106131/
2. https://swayam.gov.in/nd1_noc19_cs47/preview
3. https://www.coursera.org/specializations/algorithms

Course Assessment:

ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

MSE:

- To be conducted as written examination for 20 marks (on 40% - 50% syllabus)

End Semester Examination:

$ ESE of duration 03 hours are of 80 marks and scaled to 60.

1. Question paper will comprise of 03 questions.
2. Question1 (20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
3. Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
4. Question3 (20 marks):- Solve any 04 out of 06. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
AIMLC404	Critical Thinking & Design	02	-	-	02	-	-	02

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE[$]			
		ISE	MSE				
AIMLC404	Critical Thinking and Design	15	15	45	--	--	75

Pre- requisite: None

Program Outcomes Addressed

1. PO2: Problem Analysis
2. PO3: Design/Development of Solutions
3. PO5: Engineering Tool Usage
4. PO6: The Engineer and The World
5. PO7: Ethics
6. PO8: Individual and Collaborative Team Work
7. PO9: Communication
8. PO10: Project Management and Finance
9. PO11: Life-Long Learning

Course Objectives:

1. To describe the fundamentals of critical thinking and fair-minded reasoning for effective decision-making.
2. To differentiate personal thinking stages and implement structured strategies for continuous cognitive growth.
3. To analyze key elements of thought and intellectual standards to enhance logical reasoning.
4. To examine the principles of design thinking and apply them to solve real-world problems through an iterative, user-centered approach.
5. To demonstrate hands-on experience with idea generation, customer insights, and problem framing to drive innovation.
6. To employ creative problem-solving techniques such as brainstorming, prototyping, and hypothesis validation to design user-centric solutions.

Course Outcomes: Learners will be able to

1. Interpret the fundamentals of critical thinking and fair-minded reasoning for effective decision-making.
2. Identify their cognitive development stage and implement structured strategies to progress as a

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critical thinker.

3. Apply intellectual standards like clarity, accuracy, and logic to improve reasoning and problem-solving skills.
4. Integrate design thinking principles to create innovative, balanced, and user-centered solutions.
5. Develop a broad perspective in understanding customer needs and effectively define problem statements using diverse methodologies.
6. Implement creative solutions and enhance ideas through iterative prototyping and user feedback using brainstorming techniques.

Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Introduction to Critical Thinking**	**4**	
	1.1	**Introduction:** Start-up definitions of Critical Thinking how skilled are you as a Thinker? Hard Work, Concept of Critical Thinking, establish new habits of thoughts, Develop confidence		**CO1**
	1.2	**Fair-minded Thinker:** Weak Vs. Strong Critical Thinking Requirement of Fair-mindedness Intellectual: Humility, Courage, Empathy, Integrity, Perseverance, Autonomy Interdependence of Intellectual Virtues		
		Self-Learning Topics: Role of Intellectual Humility in Decision-Making		
2.0		**Four Stages of Development, Game Plan**	**3**	
	2.1	**Four Stages of Development:** Stage 1: Unreflective thinker, Stage 2: Challenged thinker, Stage 3: Beginning thinker, Stage 4: Practicing thinker		**CO2**
	2.2	**Game Plan:** Purpose & Key Components of Game Plan, Integrating of Game Plan Strategies		
	2.3	**Self-Learning Topics:** Case Study: Explores how a student progresses through four stages using self-reflection& discipline.		
3.0		**Self-Understanding, Parts & Universal Standards**	**3**	
	3.1	**Three Distinctive Functions:** Recognize the Mind's Three Distinctive Functions; Special Relationship		**CO3**
	3.2	**Thoughts & Intellectual Standards:** Fundamental structures of thought, The elements of thought, Universal Intellectual Standards: Clarity, Accuracy, Precision, Relevance, Depth, Breadth, Logic, Significance, Fairness		
		Self-Learning: Recognizing biases and promoting ethical decision-making.		
4.0		**Design Thinking & its Key Tenets**	**5**	
	4.1	**Design Thinking Basics:** Traditional Model vs. Design		**CO4**

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		Thinking, Five Stages: Inspire, Empathize, Define, Ideate, Prototype & Test Scale Thinking: Lean Thinking, Critical Thinking, Lateral Thinking, Design Thinking		
	4.2	**Key Tenets:** Customer-Centric Approach, Thinking Beyond Products, Balancing Desirability, Feasibility & Viability, Broad & Compartmentalized Thinking, Visual Thinking & Hands-on Approach		
		Self-Learning: Case Study: How a global brand used design thinking to enhance customer experience and increase engagement.		
5.0		**Inspire, Empathize and Define**	**5**	
	5.1	**Generating & Broadening Ideas:** Creating Stretch Goals, Power of Metaphors & Widening Perspectives, Importance of Diversity in Ideation		**CO5**
	5.2	**Empathize & Define:** New Channels for Customer Insights, Deep Customer Empathy & Stakeholder Analysis, Leveraging Technology for Insights, Mind Mapping: Stakeholders, Journey Mapping, Problem Framing		
		Self-Learning: Case Study: How Airbnb used empathy mapping and customer insights to redefine its business model.		
6.0		**Ideate, Prototype and Test**	**6**	
	6.1	Ideate: Brainstorming & Hybrid Ideation Techniques, Challenging Assumptions & Breaking Patterns, Cross-Industry Inspiration (Analogous Design), Designing for Extreme Users & Ideation Triggers		**CO6**
	6.2	Prototype & Test: Rapid Prototyping & Hypothesis Validation, Storyboarding & Scenario Visualization, Collecting Feedback & Managing Failed Prototypes		
		Self-Learning: Case Study: Explore Apple's iterative prototyping process in designing user-friendly products.		
		Total	**26**	

Textbooks:

1. Richard Paul, Linda Elder, “Critical Thinking: Tools for Taking Charge of Your Learning and Your Life”, Fourth Edition, 2022, Pearson Education
2. Pavan Soni, “Design Your Thinking: The Mindsets, Toolsets, and Skill Sets for Creative Problem-solving”,2020, Penguin Random House India Private Limited

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Reference books:

1. Roger L. Martin,"The Design of Business: Why Design Thinking is the Next Competitive Advantage",2009, Harvard Business Press
2. Richard Paul, Robert Niewoehner, Linda Elde,"The Thinker's Guide to Engineering Reasoning, 2019, Rowman & Littlefield Publishers, **ISBN-13:** 978-1538133798
3. Tilmann Lindberg, Christoph Meinel, Ralf Wagner, Christo, "Design Thinking: Creating a Culture of Innovation", Springer
4. Brooke Noel Moore & Richard Parker,"Critical Thinking"13th Edition,2020,McGraw-Hill Education

Online References:

1. https://onlinecourses.nptel.ac.in/noc19_mg60/preview
2. https://onlinecourses.nptel.ac.in/noc20_de03/preview
3. https://onlinecourses.swayam2.ac.in/imb24_mg37/preview
4. https://www.coursera.org/learn/uva-darden-design-thinking-innovation

Course Assessment:

ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

MSE:

- To be conducted as written examination for 20 marks (on 40% - 50% syllabus)

End Semester Examination:

$ESE duration of 02 hours are of 60 marks and scaled to 45

1. Question paper will comprise of 3 questions.
2. Question1 (15 marks): - Solve any 03 out of 04. All questions carry 05 marks each.
3. Question 2 (30 marks): - Solve any 03 out of 05. All questions carry 10 marks each.
4. Question3 (15 marks):- Solve any 03 out of 04. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
MDMC 4031	Microprocessor and Microcontroller	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE[$]			
		ISE	MSE				
MDMC 4031	Microprocessor and Microcontroller	20	20	60	--	--	100

Pre-requisites

1. FEC204: Digital system design

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design and Development of Solution

Course Objectives:

1. To equip students with the fundamental knowledge and basic technical competence in the field of Microprocessors.
2. To emphasize instruction set and logic to build assembly language programs.
3. To prepare students for higher processor / Controller architectures.
4. To understand architecture of 8051 and ARM7 core.

Course Outcomes:

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

1. Describe core concepts of 8086 microprocessor.
2. Interpret the instructions of 8086 and write assembly and Mixed language programs.
3. Appraise the architecture of advanced processors
4. Describe core concepts of 8051 micro-controller.
5. Interpret the instructions of 8051 and write assembly language programs.
6. Appraise the architecture of advanced controllers.

Module No.	Unit No.	Topics	Hrs.
1.0		**The Intel Microprocessors 8086 Architecture**	**08**
	1.1	8086CPU Architecture, Functional Pin Diagram	
	1.2	Programmer's Model	
	1.3	Memory Segmentation, Banking in 8086	
	1.4	Demultiplexing of Address/Data bus	
	1.5	Functioning of 8086 in Minimum mode and Maximum mode	
	1.6	Interrupt structure and its servicing	
		Self-Learning: Timing diagram of minimum and maximum mode	
2.0		**Instruction Set and Programming of 8086**	**05**
	2.1	Addressing Modes, Instruction set	
	2.2	Program related -Data Transfer Instructions, String Instructions, Logical Instructions, Arithmetic Instructions, Transfer of Control Instructions, Processor Control Instructions	
		Self-Learning : 8255,8259 ,8257	
3.0		**Pentium Processor**	**6**
	3.1	Comparison of 8086 and Pentium, Pentium Architecture, Superscalar Operation, Integer &Floating-Point Pipeline Stages	
	3.2	Branch Prediction Logic, Cache Organization, MESI Protocol	
		Self-learning: 80386 Processor	
4.0		**8051 Microcontroller**	**8**
	4.1	Comparison between Microprocessor and Microcontroller	
	4.2	Features, architecture and pin configuration of 8051	
	4.3	CPU timing and machine cycle	
	4.4	Memory organization	
	4.5	Counters and timers	
	4.6	Interrupts	
	4.7	Serial data input and output	
		Self-Learning : Input output ports	
5.0		**8051 Assembly Language Programming and Interfacing**	**06**
	5.1	Addressing modes, Instruction set	
	5.2	Programs related to : arithmetic, logical, delay subroutine, input, output, timer, counters, port, serial communication, and interrupts Interfacing with LEDs	
		Self-Learning : Need of Assembler & Cross Assemble, Assembler Directives	
6.0		**ARM7**	**06**
	6.1	Introduction & Features of ARM 7, Concept of Cortex-A, Cortex-R and Cortex-M	

		Architectural inheritance, Pipelining Programmer's model	
	6.2	Brief introduction to exceptions and interrupts handling Instruction set: Data processing, Data Transfer, Control flow	
		Self-Learning: Programming of ARM7	
		Total	**39**

Textbooks:

1. K. M. Bhurchandani and A. K. Ray, "Advanced Microprocessors and Peripherals", McGraw Hil
2. Douglas V Hall, SSSP Rao "Microprocessors & Interfacing", McGraw Hill
3. M. A. Mazidi, J. G. Mazidi and R. D. Mckinlay, "The 8051 Microcontroller & Embedded systems", Pearson Publications
4. C. Kenneth J. Ayala and D. V. Gadre, "The 8051 Microcontroller & Embedded system using assembly & 'C' ", Cengage Learning
5. Steve Furber, "ARM System on chip Architecture", Pearson

Reference books:

1.John Uffenbeck, "8086/8088 family: Design Programming and Interfacing", PH

Online References:

1 https://swayam.gov.in/nd1_noc20_ee11/preview
2 https://nptel.ac.in/courses/108/105/108105102/
3 https://www.classcentral.com/course/swayam-microprocessors-and-microcontrollers-9894
4 https://www.mooc-list.com/tags/microprocessors

Course Assessment:

ISE: To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.

MSE: To be conducted as written examination for 20 marks (on 40% - 50% syllabus)

End Semester Examination:

$ ESE of duration 3 hours are of 80 marks and scaled to 60.

1. Question paper will comprise of **6** questions, each carrying **20** marks.
2. The students need to solve a total of **4** questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining questions**(Q.2 to Q.6)** will be selected from all the modules

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
MDMC4041	Computer Network	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
MDMC4041	Computer Network	20	20	60	--	--	100

Pre- requisite: None

Program Outcomes Addressed

1. PO1: Engineering Knowledge
2. PO2: Problem analysis
3. PO3: Design/development of solutions
4. PO4: Conduct investigation of complex problems
5. PO5: Modern Tool Usage
6. PO6: The Engineer and The World

Course Objectives:

1. To interpret the issues and challenges of protocols design while delving into TCP/IP protocol suite.
2. To introduce concepts and fundamentals of physical layer
3. To describe various functions of Data Link Layer (DLL).
4. To compare the strengths and weaknesses of various routing algorithms.
5. To discuss various transport layer protocols.
6. To discuss various application layer protocols.

Course Outcomes: Learners will be able to

1. Discuss the concepts of data communication at physical layer and Compare ISO – OSI model with TCP/IP model.
2. Describe the various functions of Physical Layer.
3. Illustrate different design issues and error detection and correction mechanisms at data link layer.
4. Construct networks using IP addressing and sub-netting / super-netting schemes.
5. Apply transport layer protocols and congestion control algorithms to network scenarios.
6. Interpret the protocols at application layer.

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Module No.	Unit No.	Topics	Hrs.	CO
1.0		**Introduction to Networking**	**4**	
	1.1	Introduction to computer network, network application, network software and hardware components (Interconnection networking devices), Network topology, protocol hierarchies, design issues for the layers, connection oriented and connectionless services		**CO1**
	1.2	Reference models: Layer details of OSI, TCP/IP models. Communication between layers.		
	1.3	Self-Learning: ARPANET, IEEE 802.11 standards, Firewalls, VPNs, Software-Defined Networking		
2.0		**Physical Layer**	**3**	
	2.1	Introduction to Communication Electromagnetic Spectrum		**CO2**
	2.2	Unguided Transmission Media: Radio wave, Microwave, Infrared. Guided Transmission Media: Twisted pair, Coaxial, Fiber optics.		
	2.3	Self-Learning: Properties & Propagation (Line-of-Sight Communication), Satellite Communication & Radar Systems, Cellular Networks (3G, 4G, 5G)		
3.0		**Data Link Layer**	**8**	
	3.1	DLL Design Issues (Services, Framing, Error Control, Flow Control), Error Detection and Correction (Hamming Code, CRC, Checksum), Elementary Data Link protocols, Stop and Wait, Sliding Window (Go Back N, Selective Repeat)		**CO3**
	3.2	**Medium Access Control Sublayer** Channel Allocation problem, Multiple access Protocol (Aloha, Carrier Sense Multiple Access (CSMA/CD)		
	3.3	Self-Learning: Link Layer Security,		
4.0		**Network layer**	**12**	
	4.1	Network Layer design issues, Communication Primitives: Unicast, Multicast, Broadcast. IPv4 Addressing (classful and classless), Subnetting, Super netting design problems, IPv4 Protocol, Network Address Translation (NAT), IPv6		**CO4**
	4.2	**Routing algorithms:** Shortest Path (Dijkstra's), Link state routing, Distance Vector Routing, BGP		

	4.3	**Protocols –** ARP, RARP, ICMP, IGMP		
	4.4	**Congestion control algorithms:** Open loop congestion control, Closed loop congestion control, QoS parameters, Token & Leaky bucket algorithms		
	4.5	Self-Learning: EIGRP (Enhanced Interior Gateway Routing Protocol), Dynamic Source Routing (DSR), Ad-hoc On-Demand Distance Vector (AODV), Zone Routing Protocol (ZRP)		
5.0		**Transport Layer**	**6**	
	5.1	**The Transport Service**: Transport service primitives, Berkeley Sockets, Connection management (Handshake), UDP, TCP, TCP state transition, TCP timers		**CO5**
	5.2	TCP Flow control (sliding Window), TCP Congestion Control: Slow Start		
	5.3	Self-Learning: Sockets, Packet Loss Handling & Retransmission Mechanisms, Real-World Applications of TCP/UDP, QoS (Quality of Service) in Transport Protocols, Modern Enhancements to TCP (QUIC, BBR Congestion Control)		
6.0		**Application Layer**	**6**	
	6.1	DNS: Name Space, Resource Record and Types of Name Server. HTTP, SMTP, Telnet, FTP, DHCP		**CO6**
	6.2	Self-Learning: DNS Caching & Performance Optimization, SMTP Security Threats (Phishing, Email Spoofing)		
		Total	**39**	

Textbooks:

1. A.S. Tanenbaum, **Computer Networks**,4th edition Pearson Education
2. B.A. Forouzan, **Data Communications and Networking**, 5th edition, TMH
3. James F. Kurose, Keith W. Ross, **Computer Networking, A Top-Down Approach Featuring the Internet**,6th edition, Addison Wesley

Reference books:

1 S.Keshav,**An Engineering Approach To Computer Networking**, Pearson
2 Natalia Olifer & Victor Olifer,**Computer Networks: Principles, Technologies & Protocols for Network Design**, Wiley India, 2011.
3 Larry L.Peterson, Bruce S.Davie, **Computer Networks: A Systems Approach**, Second Edition ,The Morgan Kaufmann Series in Networking

Online References:

1 https://www.netacad.com/courses/networking/networking-essentials
2 https://www.coursera.org/learn/computer-networking
3 https://nptel.ac.in/courses/106/105/106105081
4 https://www.edx.org/course/introduction-to-networking

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Course Assessment:

ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

MSE:

- To be conducted as written examination for 20 marks (on 40% - 50% syllabus)

End Semester Examination:

$ ESE of duration 03 hours are of 80 marks and scaled to 60.

1. Question paper will comprise of 03 questions.
2. Question1 (20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
3. Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
4. Question3 (20 marks) :- Solve any 04 out of 06. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
MDM C4061	Cost Management	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$^{\$}$			
		ISE	MSE				
MDM C4061	Cost Management	20	20	60	--	--	100

Pre-requisite: Basic Accounting principles, Quantitative skills etc.

Program Outcomes addressed:

1.PO1: Engineering Knowledge
2. PO2: Problem analysis
3. PO11: Lifelong Learning

Course Objectives: To acquire knowledge and understanding of the concepts, techniques, and practices of cost and management accounting and to develop skills for decision making.

Course Outcomes: Upon completion of this course, learners will be able to…

CO1: To understand and analyze different cost concept and methods.
CO2: To understand the Elements of Cost & Cost classification.
CO3: To apply various material concepts & classifications for preparation of cost sheet.
CO4: To analyze various techniques of costing and its application in Finance, budgets and budgetary control.
CO5: To develop requisite data for cost control and cost reduction.
CO6: To evaluate marginal costing techniques for decision making.

Module No.	Unit No.	Topics	Hrs.	CO
1.0	**1**	**Module 1: Introduction to Cost Accounting**	**04**	**CO1**
		Meaning of Cost, Cost Accounting & its Objectives, Comparison between Cost accounting and Financial Accounting, Comparison between Cost Accounting and Management Accounting, Types of cost, Methods of costing & Techniques of costing.		
		Self-Learning: Basic accounting concepts		
2.0	**2**	**Classification of Costs and Cost Sheet**	**05**	**CO2**
		Elements of Cost, Classification of Costs, Cost center and cost unit, Preparation of Cost Sheet & Estimated Cost Sheet.		
		Self-Learning: Purpose and importance of cost sheet.		
3.0		**Material Management and Accounting for materials**	**06**	**CO3**
		Managing Purchase Functions, Cost of Material, Storing of materials – Inventory control methods, Costs associated with storing and ordering material, Economic Order Quantity, Fixation of levels and calculation of the same, Issue control-Pricing issues (LIFO, FIFO, Weighted Average), Material control -Objectives in Material Control, Stock Turnover, Material losses wastage, scrap, spoilage, defectives.		
		Self-Learning: Basic flowchart for material flow in a company.		
4.0		**Accounting for labour and Overheads**	**08**	**CO4**
		Accounting for labour: Types of Labour Cost, Methods of Remuneration, Treatment of overtime, fringe benefits, idle time etc. Accounting for overheads: Production overheads – Collection, Distribution to Production and service departments, Computation of Overheads Rate based on Machine Hour Rate method, Allocations and Apportionment, Absorption of overheads.		
		Self-Learning: Types of labour, classification of overheads.		
5.0		**Cost Control and Cost Reduction**	**10**	**CO5**
		Introduction, Comparison between cost control & cost reduction, Budgets and Budgetary Control, Meaning and Purpose of Budget, Objectives of Budgetary Control, Dangers of budget, Types of Budgets- Flexible Budget Standard Costing, Concept and development of standard costing, Variance analysis for cost, Direct Material variance- Cost, Price, usage, mix and yield variance Direct Labour Variance-Cost, Efficiency, usage, mix, yield and idle-time variance, Overhead Variance – Variable & Fixed Overhead variance,		

		Sales variances – Value, rate, volume and mix variance.		
		Self-Learning: Differences and Interplay Between Cost Control and Cost Reduction.		
6.0		**Marginal Costing & CVP Analysis**	**06**	**CO6**
		Nature and scope of Marginal Costing, Marginal Cost equation, Cost Profit volume analysis, Break Even point and Break-Even Analysis, Relevant cost analysis for decision making.		
		Self-learning: Applications of Marginal Costing in Decision Making.		
		Total	**39**	

Textbooks:

1. B. Banerjee, *Cost Accounting: Theory and Practice*, 14th ed. New Delhi, India: PHI Learning Pvt. Ltd., 2021.
2. M. Y. Khan and P. K. Jain, *Management Accounting*, 8th ed. New Delhi, India: McGraw-Hill Education, 2021.

Reference books:

1. P. Shah, *Management Accounting*, 6th ed. New Delhi, India: Oxford University Press, 2015.
2. C. Drury, *Management and Cost Accounting*, 12th ed. Andover, U.K.: Cengage Learning, 2024.

Online References:

1. https://dynamicstudyhub.com/cost-management.
2. https://www.wallstreetmojo.com/cost-management

Course Assessment:

ISE: To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 15 marks and 5 marks attendance.
MSE: To be conducted as written examination for 20 marks (on 50% syllabus)

End Semester Examination:

$ ESE of duration 03 hours are of 80 marks and scaled to 60.

1. Question paper will comprise of 03 questions.
2. Question1 (20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
3. Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
4. Question3 (20 marks) :- Solve any 04 out of 06. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
AIMLL401	Operating System Lab	--	02	--	--	01	-	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
AIMLL401	Operating System Lab	--	--	--	25	25	50

Pre-requisite:

1. AIMLC402: Operating system.

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/Development of Solutions
4. PO4: Conduct investigations of complex problems
5. PO5: Modern tool usage
6. PO9: Individual & Collaborative Team work
7. PO10: Communication

Lab Objectives:

1. To gain practical experience with designing and implementing concepts of operating systems such as system calls, CPU scheduling, process management, memory management, file systems and deadlock handling using C language in Linux environment.
2. To familiarize students with the architecture of Linux OS.
3. To provide necessary skills for developing and debugging programs in Linux environment.
4. To learn programmatically to implement simple operation system mechanisms.

Lab Outcomes:

Upon completion of this course, learners will be able to…

1. Illustrate basic Operating system Commands, Shell scripts, System Calls.
2. Simulate and implement various processes, scheduling algorithms and evaluate their performance.
3. Analyze and experiment various methods of synchronization and deadlocks.
4. Show various Memory Management techniques and evaluate their performance.
5. Illustrate and analyze concepts of virtual memory.
6. Implement and analyze concepts of file management and I/O management techniques.\

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Suggested List of Experiments			
Sr. No.		**Content**	**LO**
1		**Explore Linux Commands**	
	1.1	Explore usage of basic Linux Commands and system calls for file, directory and process management. For eg: (mkdir, chdir, cat, ls, chown, chmod, chgrp, ps. system calls: open, read, write, close, getpid, setpid, getuid, getgid, getegid, geteuid. sort.)	**LO1**
	1.2	Implement any one basic commands of linux like ls, cp, mv and others using kernel APIs.	
2		**Linux shell script**	
	2.1	To write shell script a. Write a grep/egrep script to find the number of words character, words and lines in a file. b. Write an awk script to develop a Fibonacci series. c. Write an awk script to display the pattern of given string or number. d. Write an egrep script to display list of files in directory	**LO1**
	2.2	Write shell scripts to do the following: a. Display OS version, release number, kernel version b. Display top 10 processes in descending order c. Display processes with highest memory usage. d. Display current logged in user and log name. e. Display current shell, home directory, operating system type, current path setting, current working directory.	
3		**Linux- Process**	
	3.1	a. Create a child process in Linux using the fork system call. From the child process obtain the process ID of both child and parent by using getpid and getppid system call. b. Explore wait and waitpid before termination of process.	**LO1**
4		**Process Management: Scheduling**	
	4.1	a. Write a program to demonstrate the concept of non-preemptive scheduling algorithms. b. Write a program to demonstrate the concept of preemptive scheduling algorithms	**LO2**
5		**CPU-OS simulator**	
	5.1	Using the **CPU-OS simulator** analyze and synthesize the following: a. Process Scheduling algorithms. b. Thread creation and synchronization. c. Deadlock prevention and avoidance.	**LO2**
6		**Process Management: Synchronization**	

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	6.1	Write a C program to implement solution of Producer consumer problem through Semaphore	**LO3**
7		**Process Management: Deadlock**	
	7.1	a. Write a program to demonstrate the concept of deadlock avoidance through Banker's Algorithm Write a program demonstrate the concept of Dining Philospher's Problem	**LO3**
8		**Memory Management**	
	8.1	a. Write a program to demonstrate the concept of MVT and MFT memory management techniques Write a program to demonstrate the concept of dynamic partitioning placement algorithms i.e. Best Fit, First Fit, Worst-Fit etc.	**LO4**
9		**Memory Management: Virtual Memory**	
	9.1	a. Write a program to demonstrate the concept of demand paging for simulation of Virtual Memory implementation Write a program in C demonstrate the concept of page replacement policies for handling page faults eg: FIFO, LRU etc.	**LO5**
10		**File Management & I/O Management**	
	10.1	a. Write a C program to simulate File allocation strategies typically sequential, indexed and linked files b. Write a C program to simulate file organization of multi-level directory structure. Write a program in C to do disk scheduling - FCFS, SCAN, C-SCAN	**LO6**

Text Books:

1. William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 8th Edition, 2014.
2. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley &Sons, Inc., 9thEdition, 2016.
3. Linux Kernel Book, by Remy Card, Eric Dumas, Frank Mevel, Wiley India.
4. Unix Concepts and Applications, Sumitabha Das, McGraw Hill.

Reference Books:

1. Practicing Hand Book for Operating System Laboratory by Sathish Kumar Ravichandran, Archana Sasi.
2. Operating System Lab Programs: Guide to Shell and OS lab programs by S.Sydhani Begum
3. Maurice J. Bach, "Design of UNIX Operating System", PHI

Term Work will be assessed as **Continuous Internal Assessment Practical (CIAP).**

1. Term work should consist of 10 experiments covering all modules.
2. Journal must include at least 2 assignments on content of theory and practical of "Operating System"

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3. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4. Total 25 Marks (Experiments: 15-marks, Attendance Theory& Practical: 05-marks, Assignments: 05-marks)

Practical Exam: (2 hours/ 25 Marks)

End-semester Practical and oral exam will be held based on the above syllabus and will be assessed as **End Semester Examination Practical (ESEP).**

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
AIMLL402	Analysis of Algorithm Lab	--	02	--	--	01	-	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
AIMLL402	Analysis of Algorithm Lab	--	--	--	25	25	50

Pre-requisite:

1. FEC104:C-Programming and
2. AIMLC302: Data Structure

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO4: Conduct investigations of complex problems
4. PO9: Individual and team work
5. PO10: Communication
6. PO12: Life-long learning

Lab Objectives:

1. To introduce the methods of designing and analyzing algorithms.
2. Design and implement efficient algorithms for a specified application.
3. Strengthen the ability to identify and apply a suitable algorithm for the given real-world problem.
4. Analyze worst-case running time of algorithms and understand fundamental algorithmic problems.

Lab Outcomes:

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

1. Implement the algorithms using different approaches.
2. Analyze the complexities of various algorithms.
3. Compare the complexity of the algorithms for specific problems.
4. Use appropriate algorithms to solve computational problems
5. Implement advanced problem-solving techniques like backtracking and branch & bound
6. Understanding complexity classes through implementation and case studies.

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Suggested List of Experiments:		LO Mapping
Sr. No.	**Title of Experiments**	**LO1, LO2**
1	Implementation of Selection Sort and Insertion Sort.	**LO1, LO2**
2	Implementation of Merge Sort and Quick Sort.	**LO1, LO2**
3	Implementation of Binary Search.	**LO1, LO3**
4	Implementation of Dijkstra's Algorithm for Single Source Shortest Path.	**LO1, LO3**
5	Implementation of Prim's Algorithm for Minimum Spanning Tree (MST).	**LO1, LO3**
6	Implementation of 0/1 Knapsack Problem using Dynamic Programming.	**LO1, LO3**
7	Implementation of Floyd-Warshall Algorithm all pair shortest path.	**LO1, LO3**
8	Implementation of Longest Common Subsequence.	**LO1, LO3**
9	Implementation of the N-Queen Problem using Backtracking.	**LO1, LO3**
10	Implementation of Rabin Karp String Matching Algorithm.	**LO1, LO3**
11	Implementation of Graph Coloring algorithm.	**LO1, LO3**
12	Write a case study on Complexity Classes: P, NP, NP-Hard, NP-Complete.	**LO2, LO3**

Textbooks:

1. Introduction to Algorithms by T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein was published by PHI Publication in 2005
2. Fundamentals of Computer Algorithms by Ellis Horowitz,Sartaj Sahni, and Sanguthevar Rajasekaran is the second edition, published by Orient BlackSwan in 2008.

Reference books:

1. Algorithms by Sanjoy Dasgupta,Christos Papadimitriou and Umesh Vazirani was published by McGraw-Hill Education in 2006.
2. Design Methods and Analysis of Algorithms by S. K. Basu was published by PHI Learning Pvt. Ltd. in 2005.

Online References:

1. https://nptel.ac.in/courses/106/106/106106131/
2. https://swayam.gov.in/nd1_noc19_cs47/preview
3. https://www.coursera.org/specializations/algorithms

Term Work:

The term work should include 10 experiments. At least 02 assignments covering the entire syllabus must be given on the content of theory of "Analysis of Algorithms". The assignments should be students' centric and an attempt should be made to make assignments more meaningful, interesting and innovative. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks:

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25 Marks (Total Marks) =15 Marks (Experiment) + 05 Marks (Assignments) + 05 Marks (Attendance)

The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.

Practical Exam: (2 hours/ 25 Marks)

End-semester Practical and oral exam will be held based on the above syllabus and will be conducted as End Semester Examination Practical (ESEP).

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
AIMLL403	Skill Lab: Linux System & Networking Lab	--	2*+2	--	--	02	--	02

***** Theory class to be conducted for full class

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
AIMLL403	Skill Lab: Linux System & Networking Lab	--	--	--	25	25	50

Pre-requisite:
1. FEC104 – C-Programming
2. AIMLL304 – Skill Lab (Python Programming)

Program Outcomes Addressed:
PO1: Engineering Knowledge
PO2: Problem Analysis
PO5: Engineering Tool Usage
PO6: The Engineer and The World
PO7: Ethics
PO8: Individual and Collaborative Teamwork
PO11: Life-Long Learning

Lab Objectives:
1. To install and configure Linux operating systems and perform essential system administration tasks.
2. To execute and manage Linux commands for users, permissions, process control, and file systems.
3. To configure Linux-based network services such as SSH, FTP, DNS, and perform remote management.
4. To understand and simulate the functions of networking devices and protocols using real tools and simulators.
5. To analyze packet flow and TCP/IP protocol behavior using Wireshark and related tools.
6. To design and configure networks using static/dynamic IP addressing, implement routing protocols, and develop network-based applications.

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Lab Outcomes: Learners will be able to

1. Install and configure Linux OS and manage system-level tasks like file handling, user permissions, and background processes.
2. Apply various Linux commands to manage system operations and networking configurations.
3. Configure and operate key network services like FTP, SSH, DHCP, DNS on Linux platforms.
4. Simulate and analyze the working of networking devices and use network-related commands in practical setups.
5. Examine packet formats and functioning of each layer in the TCP/IP model using packet capture tools like Wireshark.
6. Design IP addressing schemes, configure routers/switches, implement routing algorithms (RIP, OSPF, NAT), and demonstrate application-layer protocols.

Module No.	Unit No.	Topics	Hrs.	LO
1.0		**Introduction to Open-Source Software**	**4**	**LO1**
	1.1	Need of Open Sources, Advantages and applications of Open sources, FOSS – FOSS usage, Free Software Movement, Open-Source Software Development Model, comparison with close source / Proprietary software, widely used open source software license: Apache License 2.0, BSD license, GNU General Public License, MIT License, Mozilla Public License 2.0		
	1.2	**Installation of Linux (Redhat-CentOS-Fedora-Ubuntu):** Linux Architecture, Kernel and shells, Boot Process, bootloader, understanding FHS of Linux, Understanding the different types of run-levels, understanding different types of shutdown commands,		
		Self-Learning Topics: Contributing to Open-Source Projects, Automation in Linux		
2.0		**Open-Source Operating System: System Administration Task**	**4**	**LO2**
	2.1	**Basic Command Line:** Working with the Bash Shell, Getting the Best of Bash, Useful Bash Key Sequences, Working with Bash History, Performing Basic File System Management Tasks, Working with Files and Directories, Piping and Redirection, Finding Files, Working with Links		
	2.2	**Process management Task:** Performing Job management Tasks, System and Process Monitoring and management, Managing Process Niceness, Scheduling Jobs using CRON, Creating Backups		
		Self-Learning Topics: Disk Management and Partitioning, Log Management and Monitoring		

3.0		**Storage and Network Management in Open-Source Operating Systems**	**5**	**LO3**
	3.1	**Storage Configuration and Management:** Understanding Partitions and Logical Volumes, Creating Partitions, File Systems Overview, Creating File Systems, Mounting and Unmounting File systems, Mounting File Systems Automatically Through fstab, Working with Logical Volumes, Creating Logical Volumes, Resizing Logical Volumes, Creating Swap Space, Working with Encrypted Volumes		
	3.2	**Network Management:** Understanding Network Manager, Network Manager Configuration Files, Network Service Scripts, Networking from the Command Line, Troubleshooting Networking, Setting Up IPv4 and IPv6, Configuring SSH, Enabling the SSH Server, Using the SSH Client, Using PuTTY on Windows Machines, Configuring Key- Based SSH Authentication, Using Graphical Applications with SSH, Using SSH Port Forwarding, Configuring VNC Server Access		
		Self-Learning Topics: Automating Storage Management with LVM,Setting Up a Secure File Server with NFS and Samba		
4.0		**Open-Source Operating System: Server Administration Task**	**5**	**LO4**
	4.1	**Configuring Server for File Sharing:** What is NFS? Advantages and Disadvantages of NFS, Configuring NFS4, Setting Up NFSv4, Mounting an NFS Share, Making NFS Mounts Persistent, Configuring Automount, Understanding the features and advantages of FTP server, Configuring FTP server and FTP clients, Understanding FTP Basic Commands		
		Self-Learning: Database Optimization in MySQL ,Advanced Apache Web Server Configuration		
5.0		**Advanced Shell Scripting:**	4	**LO5**
	5.1	**Advanced Shell Scripting Concepts**: I/O Redirections, Functions, Arrays, Process Substitution, Command Chaining		
	5.2	**Text Processing & Manipulation**:AWK, GAWK, SED, CUT, REGEX		
	5.3	**Web using Shell Script:** Downloading web pages, Parsing Data, Using CURL		

		Self-Learning: Web Scraping Using Shell Scripts, Regular Expressions in Shell Scripting		
6.0		**Advanced System Security and Performance Optimization:**	**4**	**LO6**
	6.1	**Vulnerability Assessment and Penetration Testing :** Advanced Port Scanning & Service Detection using Nmap, Vulnerability Scanning with OpenVAS/Nessus, Phases of penetration testing, Overview of Metasploit		
	6.2	Kernel and Network Performance Optimization: Kernel Parameters for Network Performance (sysctl optimizations),Buffer Tuning for improved system efficiency, Using ethtool for Interface Optimization Load Balancing & Traffic Shaping, Network Throughput Testing with iperf3		
		Self-Learning: Kernel Performance Optimization, Network Performance Optimization.		
		Total	**26**	

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Suggested List of Experiments:		LO
Sr. No.	Title of Experiments	
1	Installation of Red HAT/Centos/Fedora Linux operating system using following method CD-ROM, Network Installation or Kickstart Installation. a. Partitioning drives b. Configuring boot loader (GRUB/LILO) c. Updating and upgrading the system d. Shutting down and reboot	**LO1**
2	Learning and executing Linux commands for a. Interacting with BASH shell and built-in shell variables b. Navigation c. File and directory management d. Working with links e. Searching files	**LO1,LO2**
3	Learning and executing Linux commands for Process management tasks like a. Executing a process b. Getting process info c. Killing a process d. Changing process attributes e. Managing foreground and background processes f. Scheduling automated jobs using CRON jobs	**LO1,LO2**
4	Learning and executing Linux commands for managing Users, Groups, and Permissions a. Creating, modifying and deleting users b. Creating, modifying and deleting groups c. Managing file permissions, attributes and ownerships d. Setting Default Permissions with umask e. Setting up access control list for files and directories	**LO1**
5	Learning and executing Linux commands for managing Storage drives in Linux environment a. Create partitions b. Install file system c. Mount and unmount partitions manually from CLI d. Automated mounting using fstab e. Encrypt volumes	**LO1**
6	Learning and executing Linux commands for managing networking in Linux environment a. Enable networking services from command line b. Configure IP and other network settings from command line. c. Configure IP and other network settings from configuration files. d. Configure SSH based services for CLI and GUI access on remote machines.	**LO2**
7	Install and configure an NFS server and mount NFS shares on Linux	**LO3**

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	Environment, Install and configure files sharing services using FTP server, Install and configure DHCP server, DNS server, Install and configure TELNET server, SSH server	
8	Understand the working of networking devices.	**LO4**
9	Use Wire shark to understand the operation of TCP/IP layers: • Ethernet Layer: Frame header, Frame size etc. • Data Link Layer: MAC address, ARP (IP and MAC address binding) • Network Layer: IP Packet (header, fragmentation), ICMP (Query and Echo) • Transport Layer: TCP Ports, TCP handshake segments etc. Application Layer: DHCP, FTP, HTTP header formats	**LO5**
10	Design a network and understand the basic working of PING (ICMP) and ARP (DLL).	**LO4**
11	a) Setup a LAN network using Static/ Dynamic IPs and assign multiple IPs . b) Using netstat and route commands of Linux, do the following: • View current routing table • Add and delete routes • Change default gateway c) Perform packet filtering by enabling IP forwarding using IP tables in Linux.	**LO4,LO6**
12	Configure a network and Implement Static Routing.	**LO6**
13.	Configure a Network and Distance Vector Routing protocol (RIP). An organization is granted a block of addresses with the beginning address 14.24.74.0/24. The organization needs to have 3 subblocks of addresses to use in its three subnets as shown below: • One subblock of 120 addresses. One subblock of 60 addresses. One subblock of 10 addresses.	**LO6**
14.	An organization is granted the block 130.34.12.64/26.The organization needs 4 subnets each with equal no hosts. Design the sub networks, find the information about each n/w and implement NAT.	**LO6**
15.	Use simulator (Eg. NS2) to understand functioning of ALOHA, CSMA/CD	**LO4**

Text Books:

1. Linux: The Complete Reference, Sixth Edition by Richard Petersen, McGraw Hill Education; 6th edition (1 July 2017)
2. Linux Command Line and Shell Scripting Bible by Richard Blum Wiley; 3rd edition (17 March 2015)
3. Red hat Linux Networking and System Administration, by Terry Collings and Kurt Wall, Wiley 3rd edition 2005

Reference Books:

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1. Linux Administration: A Beginner's Guide by Wale Soyinka, McGraw-Hill Education; 8th edition (28 April 2020)
2. Red Hat Enterprise Linux 6 Administration, Real World Skills for Red Hat Administrators by Sander van Vugt, John Wiley and Sons 2013
3. Rhcsa Red Hat Enterprise Linux 8: Training and Exam Preparation Guide, Asghar Ghori, Endeavor Technologies (10 January 2020)

Software Resources:

1. https://www.virtualbox.org/wiki/Downloads
2. https://getfedora.org/
3. https://www.centos.org/download/
4. https://ubuntu.com/download/desktop
5. https://developers.redhat.com/products/rhel/download

Online Resources: (browser-based terminals)

1. https://distrotest.net/
2. https://bellard.org/jslinux/
3. http://www.webminal.org/terminal/
4. https://www.tutorialspoint.com/unix_terminal_online.php

Online Resources: (Study Resources)

1. https://training.linuxfoundation.org/training/introduction-to-linux/
2. https://www.netacad.com/courses/os-it/ndg-linux-unhatched
3. https://www.netacad.com/courses/os-it/ndg-linux-essentials
4. https://www.edx.org/course/fundamentals-of-red-hat-enterprise-linux
5. https://linuxhandbook.com/tag/bash-beginner/
6. https://www.learnshell.org/
7. https://itsfoss.com/shell-scripting-resources/

Course Assessment:

ISE: To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 15 marks.

MSE: To be conducted as written examination for 15 marks (on 40% - 50% syllabus)

End Semester Examination:

$ ESE of duration 2 hours are of 60 marks and scaled to 45.

1. Question paper will comprise of **6** questions, each carrying **15** marks.
2. The students need to solve a total of **4** questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining questions **(Q.2 to Q.6)** will be selected from all the modules.

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	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
AIMLL404	Value Education (UHV)	--	04	--	--	02	-	02

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
AIMLL404	Value Education (UHV)	--	--	--	50	--	50

Program Outcome mapped:

- **Engineering Knowledge** – Apply mathematics, science, and engineering fundamentals to solve complex problems.
- **Problem Analysis** – Identify, formulate, and analyze engineering problems using foundational principles.
- **Design/Development of Solutions** – Design solutions and systems that meet specified needs with safety and sustainability considerations.
- **Investigation of Complex Problems** – Conduct research and use scientific methods to analyze and solve engineering challenges.
- **Modern Tool Usage** – Utilize appropriate techniques, resources, and modern engineering tools for problem-solving.
- **Engineer and Society** – Assess societal, health, safety, and legal aspects relevant to professional engineering.
- **Environment and Sustainability** – Understand and apply sustainable development principles in engineering solutions.
- **Ethics** – Uphold ethical principles and professional responsibilities in engineering practice.
- **Individual and Team Work** – Function effectively as an individual and as a member or leader in diverse teams.
- **Communication** – Communicate complex engineering activities effectively through reports, presentations, and instructions.
- **Project Management and Finance** – Apply engineering and management principles to project execution and financial decision-making.
- **Lifelong Learning** – Recognize the need for and engage in continuous learning to keep pace with technological advancements.

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Course Objectives:

1. **To introduce the fundamental concepts of human values**, including intrinsic and extrinsic values, and their relevance to personal and professional development in the context of IT engineering.
2. **To explore the principles of Universal Human Values (UHV)**, emphasizing self-awareness, self-exploration, and the application of tools like the JOHARI window and SWOT analysis in the IT profession.
3. **To study the different levels of harmony**—within oneself, in the family, society, and nature—and apply these concepts to achieve a balanced and fulfilling life, especially in the fast-paced IT industry.
4. **To comprehend the key aspects of professional ethics in IT**, including ethical standards, work ethics, and moral issues such as data privacy, cybersecurity, and AI ethics.
5. **To develop foundational values** such as integrity, impartiality, nonpartisanship, and objectivity, and cultivate empathy, tolerance, and compassion in both personal and professional contexts, particularly in IT-related decision-making.
6. **To integrate human values into IT practices**, focusing on ethical decision-making, sustainable technology development, and responsible innovation.

Course Outcomes:

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

- **Understand and Explain** (*Understand*) the basic concepts of human values and their significance in personal and professional contexts, particularly in the IT industry.
- **Explore and Internalize** (*Apply*) human values to guide personal behavior and professional conduct in IT roles such as software development, data analysis, and cybersecurity.
- **Analyze and Apply** (*Analyze & Apply*) the concept of harmony at various levels of existence to achieve a balanced life, even in high-pressure IT environments.
- **Identify and Evaluate** (*Analyze & Evaluate*) ethical issues in the IT profession, including data privacy, cybersecurity, AI ethics, and intellectual property rights, using appropriate ethical theories and standards.
- **Demonstrate and Uphold** (*Apply & Evaluate*) integrity and ethical principles in professional and public service contexts, fostering empathy and compassion in IT projects that impact society.
- **Integrate and Implement** (*Create & Apply*) human values into IT practices, ensuring that technology development aligns with ethical, social, and environmental considerations.

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Course Modules and Topics:

Module No.	Unit No.	Topics	LO
1.0		**Introduction to Human Values and Their Relevance in IT**	**LO1**
	1.1	Definition, Intrinsic & Extrinsic values, Shalom Schwartz's Theory of Basic Human Values, Value education: Need, Basic Guidelines and Scope, Self-exploration, Happiness and Prosperity, Harmony, Self-awareness: JOHARI window and SWOT analysis	**LO1**
	1.2	Ethical Challenges in IT: Data privacy, cybersecurity, AI ethics, and intellectual property rights	**LO4**
2.0		**Understanding Human Beings and Harmony at Various Levels of Existence**	**LO3**
	2.1	Human beings as a combination of the conscious 'I' and material body, Abraham Maslow's Hierarchy of Needs, Classification between I & Body, Co-existence, Harmony in Self: Swasthya and Sanyama	**LO3**
	2.2	Harmony in the Family -- Understanding Values in Human Relationships, Differentiation in relationships, Values in relationships	**LO3**
	2.3	Harmony in the Society -- From Family order to World Family Order, Comprehensive Human Goal, Harmony in Nature -- Understanding the Interconnectedness and Mutual Fulfilment, Understanding the Four Orders of Nature	**LO3, LO6**
3.0		**Professional Ethics in IT**	**LO4**
	3.1	Definition, Characteristics, Profession, Professionalism, Morality, Moral issues in the IT profession, Understanding Ethics, Ethical Standards, Work Ethics, Engineering Ethics	**LO4**
	3.2	Types of Inquiries, Kohlberg's Theory, Heinz Dilemma, Gilligan's Theory, and Ethical Theories	**LO4**
	3.3	Ethical Challenges in IT: Data privacy, cybersecurity, AI ethics, and intellectual property rights	**LO4**
4.0		**Ethics, Integrity, and Aptitude in IT**	**LO5**
	4.1	Essence, determinants, and consequences of ethics in human actions, Dimensions of ethics, Ethics in private and public relationships	**LO5**

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Module No.	Unit No.	Topics	LO
	4.2	Key contributions from Indian and global moral thinkers and philosophers, emphasizing integrity, impartiality, and non-partisanship in professional settings	**LO5**
	4.3	Upholding objectivity and dedication to public service, Cultivating empathy, tolerance, and compassion, with a focus on their application in IT and public welfare	**LO5**
5.0		**Understanding Harmony in Nature and Sustainable IT Practices**	**LO6**
	5.1	Concept of harmony in Nature: Meaning of harmony in nature, Disharmony with Nature -- causes, Implications of disharmony with nature	**LO6**
	5.2	Maintaining harmony with nature: Harmony through mutual fulfilment of the four orders in nature, Harmony through symbiotic relationship with nature, Achieving competence in maintaining harmony with nature in professional life	**LO6**
	5.3	Sustainable IT Practices: Green computing, energy-efficient algorithms, and eco-friendly technology development	**LO6**
6.0		**Practicum Project -- Community Engagement and IT for Social Good**	**LO2, LO5, LO6**
	6.1	Students carry out a community engagement project to benefit the local community through IT-based initiatives (e.g., developing apps for social causes, organizing digital literacy camps, or creating awareness about cybersecurity).	**LO2, LO5, LO6**
	6.2	Students write a reflective report on how the understanding of universal human values has been integrated into their IT project.	**LO5, LO6**

Textbooks:

1. Naagarazan, R. S. *A Textbook on Professional Ethics and Human Values*. 4th Edition. New Age International Publishers, 2021.
2. Gaur, R.R., Sangal, R., & Bagaria, G.P. *A Foundation Course in Human Values and Professional Ethics*. 3rd Edition. Excel Books, 2019.
3. Khosla, Vaishali R., & Bhagat, Kavita. *Human Values and Professional Ethics*. 2nd Edition. Macmillan Education, 2020.
4. Harris, C.E., Pritchard, M.S., & Rabins, M.J. *Engineering Ethics: Concepts and Cases*. 6th Edition. CENGAGE Learning, 2019.

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5. Murthy, PSR. *Indian Culture, Values and Professional Ethics*. 4th Edition. BS Publications, 2022.

Reference Books:

1. Kumar, Niraj. *Lexicon for Ethics, Integrity & Aptitude for IAS General Studies Paper IV*. 2nd Edition. McGraw Hill Education, 2023.
2. Subba Rao, G., & Roy Chowdhury, P. N. *Ethics, Integrity & Aptitude*. 3rd Edition. McGraw Hill Education, 2020.

Online References:

1. **https://fdp-si.aicte-india.org/index.php**
2. **https://example.com/**

Course Assessment:

Internal Assessment Method (With Rubrics)
The internal assessment will consist of Continuous Internal Assessment (CIAP) = 50 marks based on Assignments, Case Studies, Presentations, and Practicum Projects.

Assessment Component	Weightage (%)	Evaluation Criteria (Rubrics)
ssignment on Human Values	**20%**	- Excellent (5): Demonstrates deep understanding with real-life examples - Good (4): Good understanding with relevant examples - Satisfactory (3): Basic understanding with minimal examples - Needs Improvement (2): Partial understanding with errors - Poor (1): Little to no understanding
Case Study on Ethical Issues in IT	**20%**	- Excellent (5): In-depth analysis with ethical theories and solutions - Good (4): Covers major ethical aspects with examples - Satisfactory (3): Identifies ethical concerns with some analysis - Needs Improvement (2): Limited understanding with minor errors - Poor (1): Lacks analysis and ethical reasoning
Presentation on Sustainability in IT	**20%**	- Excellent (5): Well-structured, engaging, innovative ideas - Good (4): Clear and logical presentation with good insights - Satisfactory (3): Covers major points but lacks depth - Needs Improvement (2): Some points missing, lacks clarity - Poor (1): Unstructured, lacks coherence

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Reflection Report on Practicum Project	**20%**	- Excellent (5): Thoughtful reflection, well-articulated impact - Good (4): Covers personal learning and impact clearly - Satisfactory (3): General reflection with limited depth - Needs Improvement (2): Superficial understanding - Poor (1): Minimal effort, lacks insight
Participation in Discussion & Engagement	**20%**	- Excellent (5): Actively participates, provides insightful contributions - Good (4): Engaged, contributes relevant thoughts - Satisfactory (3): Participates but with limited contribution - Needs Improvement (2): Rarely participates, minimal effort - Poor (1): No participation

Examples of Practicum Projects for Community Engagement and IT for Social Good

The practicum project aims to encourage students to apply **Universal Human Values (UHV)** and **Ethics in IT** to solve real-world societal challenges. Below are some project ideas along with explanations of how they integrate **human values and ethics**:

Digital Literacy Program for Underprivileged Communities

Objective: Create and conduct workshops to educate marginalized communities about basic computer skills, cybersecurity awareness, and digital payments.

Implementation:

- Design an easy-to-understand curriculum on digital literacy.
- Conduct workshops/webinars in rural schools or community centers.
- Develop a simple mobile/web application for learning digital skills.
- Educate participants about data privacy, cyber threats, and ethical internet use.

Human Values & Ethics Integration:

- **Empathy & Compassion** – Address digital divide and empower underprivileged individuals.
- **Integrity & Responsibility** – Teach ethical use of technology and responsible online behavior.
- **Public Welfare** – Ensure safe digital access for vulnerable communities.

AI-Based Cyberbullying Detection for Schools & Colleges

Objective: Develop an AI model to identify cyberbullying in chat messages and social media posts, ensuring a safer digital environment.

Implementation:

- Collect and train data on cyberbullying-related words & phrases.
- Implement a Natural Language Processing (NLP)-based chatbot to detect abusive content.
- Educate students on ethical social media behavior and reporting mechanisms.

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- Partner with schools/colleges to deploy the model in their IT systems.

Human Values & Ethics Integration:

- **Respect & Non-Partisanship** – Encourage online respectful interactions.
- **Fairness & Objectivity** – Ensure non-biased AI in content moderation.
- **Safety & Privacy** – Protect users' personal data and identity.

Green Computing Awareness & E-Waste Management App

Objective: Develop an app to educate users on sustainable IT practices and provide an e-waste collection service.

Implementation:

- Create an app that guides users on green computing practices.
- Provide nearby e-waste collection centers and reward users for recycling.
- Conduct IT industry awareness campaigns on energy-efficient computing.
- Promote the use of renewable energy in data centers.

Human Values & Ethics Integration:

- **Environmental Sustainability** – Encourage eco-friendly IT solutions.
- **Social Responsibility** – Spread awareness about ethical e-waste disposal.
- **Harmony in Nature** – Minimize IT sector's negative impact on nature.

Cybersecurity Awareness Chatbot for Senior Citizens

Objective: Build a WhatsApp or Telegram chatbot that assists senior citizens in identifying and avoiding online scams, phishing, and frauds.

Implementation:

- Develop an AI chatbot that explains common online scams.
- Create step-by-step tutorials on safe internet banking and social media usage.
- Partner with local community centers and NGOs to spread awareness.
- Ensure chatbot provides real-time support and automated alerts.

Human Values & Ethics Integration:

- **Compassion & Empathy** – Assist vulnerable groups in safe internet use.
- **Integrity & Awareness** – Promote honest and secure online transactions.
- **Public Welfare** – Reduce cyber frauds targeting elderly people.

AI Ethics Awareness in IT Companies & Colleges

Objective: Develop an interactive website or mobile app to educate IT professionals and students on ethical AI usage and biases in AI systems.

Implementation:

- Provide interactive case studies on AI bias, privacy, and ethical dilemmas.
- Conduct quiz-based learning to test AI ethical understanding.
- Collaborate with IT professionals and faculty to design real-world scenarios.
- Ensure alignment with global AI ethics standards (e.g., IEEE, EU AI Act).

Human Values & Ethics Integration:

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- **Integrity & Fairness** – Ensure unbiased AI algorithms.
- **Public Interest** – Educate developers on responsible AI implementation.
- **Transparency** – Promote explainable and fair AI decision-making.

Mobile App for Volunteer & Donation Matching

Objective: Develop a volunteer-matching platform that connects IT professionals and students with social organizations in need of technical assistance.

Implementation:

- Allow users to register their skills (app development, cybersecurity, etc.).
- Connect them with NGOs or community projects that require IT support.
- Enable secure crowdfunding and donation tracking for transparency.
- Promote projects focused on digital inclusion and education.

Human Values & Ethics Integration:

- **Social Responsibility** – Encourage IT professionals to give back to society.
- **Transparency & Trust** – Maintain fair donation tracking.
- **Empathy & Compassion** – Align IT skills with community development.

Ethical Hacking & Cybersecurity Training for Students

Objective: Conduct a hands-on ethical hacking workshop to educate students on ethical penetration testing and cybersecurity best practices.

Implementation:

- Develop training modules on ethical hacking, cryptography, and network security.
- Conduct capture-the-flag (CTF) cybersecurity challenges for hands-on learning.
- Educate students on responsible disclosure of vulnerabilities.
- Partner with cybersecurity firms for internships and projects.

Human Values & Ethics Integration:

- **Ethical Responsibility** – Train IT students to prevent cyber crimes.
- **Accountability** – Promote responsible ethical hacking practices.
- **Public Safety** – Improve cybersecurity awareness in college networks.

AI-Powered Sign Language Recognition System

Objective: Develop an AI-based sign language recognition system to help hearing-impaired individuals communicate using real-time gesture recognition.

Implementation:

- Train a machine learning model on Indian Sign Language (ISL).
- Develop a mobile/web app that converts sign language gestures into text/speech.
- Partner with special education institutes and NGOs for deployment.
- Ensure open-source availability for future development.

Human Values & Ethics Integration:

- **Inclusion & Accessibility** – Bridge communication gaps for disabled individuals.
- **Fairness & Transparency** – Ensure AI is unbiased across different sign languages.

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- **Social Welfare** – Enhance digital accessibility for differently-abled people.

- **Project Submission & Reflection Report**

After completing the practicum project, students will submit a reflective report covering:

1. **Project Objective & Problem Statement**
2. **Implementation Details & Challenges Faced**
3. **Human Values & Ethics Integrated**
4. **Impact Assessment & Learning Outcomes**
5. **Future Improvements & Scalability**

Evaluation Rubric:

- **Excellent (5):** Clear objectives, strong ethical integration, significant social impact.
- **Good (4):** Good ethical integration, minor improvement areas.
- **Satisfactory (3):** Basic implementation lacks depth in ethical application.
- **Needs Improvement (2):** Minimal social impact, weak ethical connection.
- **Poor (1):** Unclear project execution, little relevance to human values.

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Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
AIMLM401	Mini Project 1 B	--	02	--	--	01	-	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
AIMLM401	Mini Project 1 B	--	--	--	25	25	50

Program Outcomes addressed:

1. PO1: Engineering knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solutions
4. PO4: Conduct investigations of complex problems
5. PO5: Engineering Tool Usage
6. PO6: The Engineer & The World
7. PO7: Ethics
8. PO8: Individual & Collaborative Team work
9. PO9: Communication
10. PO10: Project Management & Finance
11. PO11: Life-Long learning

Objectives

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Outcome: Upon completion of this course, learners will be able to

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as a member of a group or leader.
4. Deduce the proper inferences from available results through theoretical/ experimental /simulations.
5. Analyze the impact of solutions in societal and environmental context for sustainable development.
6. Apply standard norms of engineering practices.
7. Develop skills in written and oral communication.
8. Illustrate capabilities of self-learning in a group, which leads to life-long learning.

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9. Explain project management principles during project work.

Guidelines for Mini Project

1. Students shall form a group of 3 to 4 students, while forming a group shall not be allowed for less than three or more than four students, as it is a group activity.
2. Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
3. Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
4. A logbook to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
5. Faculty supervisors may give input to students during mini project activity; however, focus shall be on self-learning.
6. Students in a group should understand problems effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
7. Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
8. The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
9. With the focus on self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
10. However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case-by-case basis.

Guidelines for Assessment of Mini Project: Term Work

- Term work will be assessed as Continuous Internal Assessment Practical (CIAP).
- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below.
    1. Marks awarded by guide/supervisor based on logbook: 10
    2. Marks awarded by review committee 10
    3. Quality of Project report 05

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The review/progress monitoring committee may consider the following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- In the first semester the entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on the presentation given by the students' group.
  - First shall be for finalization of problem
  - Second shall be on finalization of proposed solution of problem.
- In the second semester the expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
  - The first review is based on the readiness of building a working prototype to be conducted.
  - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
  - Identification of need/problem
  - Proposed final solution
  - Procurement of components/systems
  - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
  - First shall be for finalization of problem and proposed solution
  - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project

Mini Project shall be assessed based on the following criteria;

1. Quality of survey/ need identification.
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions.
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness.
6. Societal impact.
7. Innovativeness.
8. Cost effectiveness and Societal impact.
9. Full functioning of working model as per stated requirements.
10. Effective use of skill sets.
11. Effective use of standard engineering norms.
12. Contribution of an individual's as member or leader.
13. Clarity in written and oral communication.

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- In **one year, project**, first semester evaluation may be based on the first six criteria's and the remaining may be used for second semester evaluation of performance of students in mini project.
- In the case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- The report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organization's having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on the following points.

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication

Oral & Practical exam (ESEP)

Based on the entire syllabus of CEM401 Mini Project End Semester Examination Practical (ESEP) will be conducted.

Internal Assessment:
For 03 credit - 80 marks subject Assessment consists of one Mid Semester Examination (MSE) of 20 marks and In Semester Examination (ISE) of 20 marks. The MSE to be conducted based on 50 % syllabus with duration of one hour.
For 02 credit - 60 marks subject Assessment consists of one Mid Semester Examination (MSE) of 15 marks and In Semester Examination (ISE) of 15 marks. The MSE to be conducted based on 50 % syllabus with duration of one hour.

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In Semester Examination (ISE)		
SE 20 marks = 05 marks attendance +15 marks for Activities. **ISE 15 marks = 05 marks attendance +10 marks for Activities.** The Rubrics for activities are as follows. The activities will be decided by course in charge and approved by HoD.		
Sr. No	**Rubrics**	**Marks**
1	Multiple Choice Questions (Quiz)	05 Marks
2	Literature review of papers/journals	05 Marks
3	Participation in event/ workshop/ talk / competition followed by small report and certificate of participation relevant to the subject	05 Marks
4	Extra Experiments/ Virtual Lab	05 marks
5	Content beyond syllabus presentation	05 marks
6	Wins in the event/competition/hackathon pertaining to the course	10 Marks
7	Case study, Presentation, group discussion, technical debate on recent trends in the said course	10 Marks
8	NPTEL/ Coursera/ Udemy/any MOOC Certificate course for 4 weeks or more	10 Marks
9	Creating Proof of Concept	10 Marks
10	Mini Project /	10 Marks
11	GATE Based Assignment test/Tutorials etc	10 Marks
*For sr.no.8, the date of certification exam should be within the term and in case a student is unable complete the certification, the grading has to be done accordingly.		

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