MAR IVANIOS COLLEGE(AUTONOMOUS)

Affiliated to the
University of Kerala, Thiruvananthapuram
Kerala

SCHEME AND SYLLABUS FOR THE FOUR YEAR UNDERGRADUATE PROGRAMME (FYUGP)

Courses in
COMPUTER SCIENCE
for
MACHINE LEARNING
(Aided)

(With effect from 2024 Admissions)

Approved by the Board of Studies in
Computer Science

CONTENTS

PREAMBLE

National Education Policy (NEP 2020) envisions 'higher education as playing an extremely important role in promoting human as well as societal wellbeing and in developing India as envisioned in its Constitution - a democratic, just, socially conscious, cultured, and humane nation upholding liberty, equality, fraternity, and justice for all' (Section 9.1). NEP also expects higher education 'to develop good, thoughtful, well-rounded, and creative individuals, enabling an individual to study one or more specialized areas of interest at a deep level, and also develop character, ethical and Constitutional values, intellectual curiosity, scientific temper, creativity, spirit of service, and 21st century capabilities across a range of disciplines including sciences, social sciences, arts, humanities, languages, as well as professional, technical, and vocational subjects' (Section 9.1.1). Hence, more than the creation of greater opportunities for individual employment, higher education represents the key to more vibrant, socially engaged, cooperative communities and a happier, cohesive, cultured, productive, innovative, progressive, and prosperous nation. (Section 9.1.3). NEP also identifies some of the major problems currently faced by the higher education system in India (Section 9.2) and envisions a complete overhaul and re-energizing of the higher education system to overcome these challenges and thereby deliver high-quality higher education, with equity and inclusion (Section 9.3). One of the major changes which the policy proposes is moving towards a more multidisciplinary undergraduate education (Section 9.3(b)) which develops all capacities of human beings -intellectual, aesthetic, social, physical, emotional, and moral in an integrated manner (Section 11.3). In order to achieve this in its full potential, NEP visions the adjusting of the structure and lengths of degree programmes accordingly. "The undergraduate degree will be of either 3 or 4-year duration, with multiple exit options within this period, with appropriate certifications, e.g., a certificate after completing 1 year in a discipline or field including vocational and professional areas, or a diploma after 2 years of study, or a Bachelor's degree after a 3-year programme. The 4-year multidisciplinary Bachelor's programme, however, shall be the preferred option since it allows the opportunity to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per the choices of the student." (Section 11.9)

In accordance with the NEP 2020, the UGC formulated a new student-centric "Curriculum and Credit Framework for Undergraduate Programmes (CCFUP)" incorporating a flexible choice-based credit system, multidisciplinary approach, and multiple entry and exit options and establishing three Broad Pathways,

(a) 3-year UG Degree,

(b) 4-year UG Degree (Honours), and

(c) 4-year UG Degree (Honours) with Research)

Accordingly, the Kerala Higher Education Reforms Commission 2022, headed by Prof Shyam B. Menon, has recommended a comprehensive reform in the undergraduate curriculum with the adoption of the 4-year undergraduate Programmes, which will bring undergraduate education in Kerala at par with the universities abroad. Consequently, Kerala State Curriculum Committee for Higher Education 2023 has been constituted, with Dr Suresh Das as Chairman, and they have proposed a model Kerala State Higher Education Curriculum framework for undergraduate education.

The University of Kerala has decided to introduce the Four Year Under Graduate Programmes (FYUGP) from the academic year 2024-2025 onwards in its teaching departments and all affiliated colleges, and has issued many draft documents and conducted college level awareness programmes about the same.

Mar Ivanios College, by virtue of its autonomy status, conferred in 2014 and extended in 2022, vide University Grants Commission (Conferment of Autonomous Status Upon Colleges and Measures for Maintenance of Standards in Autonomous Colleges) Regulations, 2023, has the power to review existing courses/programmes and, restructure, redesign and prescribe its own courses/programmes of study and syllabi and to formulate new courses/programmes within the nomenclature specified by UGC as per the Specification of Degrees 2014 as amended from time to time. Accordingly, the Board of Studies in Computer Science of Mar Ivanios College (Autonomous) proposed the implementation of the FYUGP scheme with effect from 2024 admission onwards and prepared the scheme and syllabi through many of the meetings and discussions. The Academic Council of the college which met on 30th April gave discussed the proposal and syllabi in detail and approved the same to be implemented from 2024 admission onwards, subject to the final directions of the University of Kerala.

The salient features of the syllabus prepared and presented by the Board of Studies include the following:

- The curriculum is designed based on Outcome Based Education (OBE) approach.
- The curriculum follows Choice-Based Credit System (CBCS): This system allows students to select courses from a prescribed list. A specified number of credits must be earned to award the degree
- The curriculum follows the basic framework, course wise/programme-wise minimum/maximum credits set by the University of Kerala for FYUGP and abides by the basic mandatory principles of **Four Year Under Graduate Programmes (UoK-FYUGP) Regulations, 2024.**
- The curriculum focuses on employability as per the requirement of the industry.

Graduate Attributes and Programme Outcomes (POs):

The National Higher Education Qualification Framework (NHEQF) envisages that students on completion of a programme of study must possess and demonstrate the expected graduate profile/attributes acquired through one or more modes of learning. The graduate profile/attributes indicate the quality and feature or characteristics of the graduate of a programme of study, including learning outcomes relating to the disciplinary area(s) relating to the chosen field(s) of learning and generic learning outcomes that are expected to be acquired by a graduate on completion of the programme(s) of study. The graduate profile/attributes include capabilities that help widen the current knowledge base and skills, gain and apply new knowledge and skills, undertake future studies independently, perform well in a chosen career, and play a constructive role as a responsible citizen in the society. The graduate profile/attributes are acquired incrementally and describe a set of competencies that are transferable beyond the study of a particular subject/disciplinary area and programme contexts in which they have been developed. Graduate profile/attributes are fostered through meaningful learning experiences made available through the curriculum and learning experience, the total college/university experience, and a process of critical and reflective thinking. Mar Ivanios College (Autonomous) is fully committed to ensuring the attainment of the necessary graduation attributes by the students. The college has clearly defined its raison de'tre, the philosophy of its existence, through the Motto "Truth Shall Liberate You" (Veritas Vos Liberabit) which refers to the ultimate enlightenment which can emerge only at the intersection of sharp intellect, sound physique, strong mind, staunch ethics, and profound spirituality. This is further made explicit through its Vision, Mission and Goals and the same expect all students who graduate from the college to:

- Have inculcated "the values of truth and charity for the protection and promotion

of human dignity and of a cultural heritage, through teaching, research, and extension activities dedicated to society";

- Be co-creators of a vibrant academic community known for its innovation, intellectual rigour and social commitment;
- Be "intellectually trained, morally upright, socially committed, spiritually inspired and ecologically conscious young men and women who would be dedicated to working for the good of society, the nation and the world";
- Have acquired "global competencies and skills";
- Have inculcated a sense of harmony, equality and fraternity among youth, transcending religious, linguistic, regional or sectional diversities; and
- Have developed "scientific temper, humanism and the spirit of inquiry and reform".

Programme Outcomes are the expected student attributes achieved by a student after the student completes the FYUGP from any of the streams/pathways.

The Programme Outcomes (POs) for the FYUGP programmes across all streams and pathways, based on the above core philosophy, and in consonance with the National Higher Education Qualifications Framework (NHEQF) are given below:

By the end of the Four-Year Under-Graduate Programme, students will:

PO 1	**Demonstrate the acquisition of all necessary knowledge and skills within their disciplinary/ multi-disciplinary areas of learning. These include the acquisition of:** • **comprehensive knowledge and coherent understanding of their chosen disciplinary/ interdisciplinary areas of study, their linkages with related fields, and the awareness of current trends in their chosen area of study;** • **essential knowledge for skilled work in chosen field(s), including self-employment and entrepreneurship skills;** • **proficiency in specialized areas within chosen fields of study, encompassing diverse practical skills applicable to different situations within those fields;** • **the ability to apply learned knowledge to novel situations, solve problems, and relate concepts to real-world scenarios rather than just memorizing curriculum content.**
PO 2	**Acquire problem-solving, critical thinking, analytical reasoning skills and demonstrate creativity in their thought processes** by demonstrating the ability to: • solve different kinds of problems in familiar and non-familiar contexts both within and outside their disciplinary/ multidisciplinary areas of learning; • apply analytic thought to a body of knowledge, including the analysis and evaluation of policies, and practices, as well as evidence, arguments, claims, and beliefs; • analyse and synthesize data from a variety of sources and draw valid conclusions and support them with evidence and examples. • the ability to plan, execute and report the results of an experiment or investigation; • adhere to scientific temper and ethics in their thought process; • adopt innovative, imaginative, lateral thinking, interpersonal skills and emotional intelligence; and

	• incubate entrepreneurial and start-up ideas.
PO 3	**Develop a profound environmental dedication by fostering ecological awareness and engaging in actions that promote sustainable development** by achieving the ability to • recognize environmental and sustainability issues, and participate in actions to promote sustainable development as well as mitigate the effects of environmental degradation, climate change, and pollution; • contribute to effective waste management, conservation of biological diversity, management of biological resources and biodiversity, forest and wildlife conservation, sustainable development and living, and the preservation of life in all forms. • participate in community-engaged services/ developmental activities and thus exemplify the ideals of community engagement and service learning and deep social commitment.
PO 4	**Accomplish perfect communication, teamwork, and leadership skills, particularly in academic and professional settings, while demonstrating nuance and attention to etiquette in all communicative contexts.** This will enable them to: • listen carefully, and read texts and research documents, and present complex information with clarity and precision to different audiences; • express thoughts and ideas and communicate effectively through speech and writing using appropriate media; • communicate using language which is respectful of gender and minority orientations; • act together as a group or a team in the interests of a common cause and working efficiently as a member of a team; • inspire the team with a vision to achieve a stated goal, and use management skills to guide the team in the right direction.
PO5	**Acquire the necessary skills, including 'learning to learn' skills, and foster innovative ideas to improve competence and employability, keeping pace with the evolving global landscape and technological advancements** by demonstrating the ability to: • pursue learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social, and cultural objectives, and adapting to changing trades and demands of the workplace, including adapting to the changes in work processes in the context of the fourth industrial revolution, through knowledge/ skill development/reskilling; • work independently, identify appropriate resources required for further learning; • acquire organizational and time management skills to set self-defined goals and targets with timelines; • be a proactive life-long learner. • use ICT in a variety of learning and work situations; • access, evaluate, and use a variety of relevant information sources, and use appropriate software for analysis of data; • navigate cyberspaces by following appropriate ethical principles and cyber etiquette. • use cutting edge AI tools with equal commitment to efficiency and ethics.

	• think 'out of the box' and generate solutions to complex problems in unfamiliar contexts;
PO6	**Develop research-related skills including the ability to conceptualize research hypotheses/projects and adopt suitable tools and methodologies for analysis** with: • a keen sense of observation, inquiry, and capability for asking relevant/ appropriate research questions; • the ability to problematize, synthesize, and articulate issues and design research proposals; • the ability to define problems, formulate appropriate and relevant research questions, formulate hypotheses, test hypotheses using quantitative and qualitative data, establish hypotheses, make inferences based on the analysis and interpretation of data, and predict cause-and effect relationships; • the capacity to develop appropriate methodology and tools for data collection; • the appropriate use of statistical and other analytical tools and techniques; • the ability to plan, execute and report the results of an experiment or investigation; • the ability to acquire the understanding of basic research ethics and skills in practicing/doing ethics in the field/ in personal research work, regardless of the funding authority or the field of study
PO7	**Assimilate a sound value system, a sense of autonomy, multicultural competence, social commitment, and the spirit of inclusivity and empathy by imbibing the spirit and the holistic ethos of the 'Multi-Dimensional Ivanian' (MDI) approach.** This will enable them to: • embrace and practice constitutional, humanistic, ethical, and moral values in life, including universal human values of integrity, truth, righteous conduct, peace, love, nonviolence, scientific temper, citizenship values; • identify ethical issues related to work, follow ethical practices and be objective, unbiased, and truthful actions in all aspects of work, including avoiding unethical behaviour such as fabrication, falsification or misrepresentation of data, or committing plagiarism, and adhering to intellectual property rights; • exercise responsibility and demonstrate accountability in applying knowledge and/or skills in work and/or learning contexts appropriate for the level of the qualification, including ensuring safety and security at workplaces; • practice responsible global citizenship required for responding to contemporary global challenges, enabling learners to become aware of and understand global issues and to become active promoters of more peaceful, tolerant, inclusive, secure, and sustainable societies; • effectively engage in a multicultural group/society and interact respectfully with diverse groups; • identify with or understand the perspective, experiences, or points of view and emotions of another individual or group. • demonstrate gender sensitivity and adopt a gender-neutral approach, as also empathy for the less advantaged and the differently-abled including

	those with learning disabilities; • demonstrate proficiency in arts/ sports/ games, physical, mental and emotional fitness, entrepreneurial /organizational /pubic speaking/environmental/ community-oriented areas by actively participating in the wide range of co-curricular activities that are available to the students of Mar Ivanios College.

Course and Credit Structure of FYUGP

The pathway preferably followed by the department will be Major with Minor or Major with multiple disciplines of study.

The Course and Credit Structure of FYUGP is given below:

Sem	DSC (4 Cr)	DSE (4 Cr)	AEC (3 Cr)	SEC (3 Cr)	MDC (3 Cr)	VAC (3 Cr)	Internship (credit-2)/ Project/ Additional Courses (credit-12)	Total courses	Total credits
I	A-1 B-1 C-1		AEC (Eng)-1 AEC(OL)-2		MDC-1			6	21
II	A-2 B-2 C-2		AEC (Eng)-3 AEC(OL)-4		MDC-2			6	21
III	A-3 B-3 C-3	DSE A -1			MDC (Kerala Studies)-3	VAC-1		6	22
IV	A-4 A-5	DSE A-2		SEC-1		VAC-2 VAC-3	Internship	6	21
V	A-6 A-7 A-8	DSE -3 DSE -4		SEC-2				6	23
VI	A-9 A-10 A-11	DSE -5 DSE -6		SEC-3				6	23
Total	A (11) B (3) C (3)	6	4	3	3	3	1*	36	133
EXIT OPTION AVAILABLE AND STUDENTS WILL BE AWARDED UG DEGREE WITH MAJOR IN A									
VII	A-12 A-13 B/C-4 B/C-5 B/C-6	DSE -7						6	24
VIII	MOOC courses A -14, A -15						Research Project/ Internship /Project or 03 courses - 12Cr	2+1**/ 3***	20
Total	A (15) B (3) C (3) B/C(3)	7	4	3	3	3	1*+1**/3***	44+1* + 1**/3***	177

A – Major Discipline
B/C-Minor/Multiple discipline
* - Mandatory Internship at the end of Semester 4

** - Research Project/ Internship /Project as part of Honours with Research
*** - Additional courses of 4 credits each.
Cr - Credits

- **Research group project for students exiting after UG 3 years:** Students who propose to exit after 3 Year UG programme can do a group project with an extra two credits to obtain research experience in discipline-specific areas of the program. The BoS can decide the number of students for the group and the evaluation criteria.
- Students will be able to take other pathways permissible under **University of Kerala Four Year Under Graduate Programmes (UoK-FYUGP) Regulations, 2024,** subject to the availability of courses/ faculty/infrastructure of the college.
- The Board of Studies shall prepare and publish a list of online courses at different levels before the commencement of classes in the respective semester offered in various online educational platforms recognised by the academic council of the college, which can be opted by the students for acquiring additional credits.

Course Participation/Attendance-

1. A student shall be permitted to register for the end-semester evaluation of a specific course to acquire the credits only if the student has completed 75% of the prescribed classroom activities in physical, online, or blended modes, as stipulated by the BoS, including any makeup activities as specified by the faculty of that particular course.
2. The reasons/cases of permissible authorised leave shall be specified by the college, with the approval of the Academic Council, ratified by the Governing Body.
3. The condonation facility shall be availed as per the existing University/college norms.

Assessment and Evaluation

1. The assessment of a course shall combine a Continuous Comprehensive Assessment (CCA) and an End Semester Evaluation (ESE).
2. For courses without practical/lab modules, 30% weightage shall be given for CCA and the remaining 70% of the weight shall be for the ESE.
3. CCA will have two sub-components: Formative Assessment (FA) and Summative Assessment (SA).
4. The CCA subcomponents will be given marks as per the following proportions:

    - Discipline specific summative assessment - 15% of the total
    - Course attendance - 5 % of the total.
    - Discipline specific formative assessment - 10% of the total.

5. The details of summative and formative assessment criteria, including that of attendance, will be specified by each course coordinator at the beginning of the semester, with the approval of the respective Head of the Department/BoS Chairperson and the Principal, and will be published on the college website.
6. For courses with practical/lab modules, 40% weightage shall be given for CCA and the remaining 60% of the weight shall be for the ESE.

7. In such cases specified in the item above, the CCA subcomponents will be given marks as per the following proportions:
   - Discipline specific summative assessment - 10% of the total
   - Course attendance - 5 % of the total.
   - Discipline specific formative assessment - 15% of the total.
   - Summative Assessment (Practical Record, Practical test, skill, etc). - 10% of the total.
8. The Course Coordinator shall be responsible for evaluating all the components of CCA for the course in question. Any grievances regarding the same shall be submitted to the Course Coordinator within 5 days of the publication of the same on the department notice board or official class group. If the grievance is not settled at the Course Coordinator level, the student is free to appeal to the Head of the Department, within the next 3 days, who will discuss the same in the Department Level Monitoring Committee (DLMC). If still needed, students can further appeal to the College Level Monitoring Committee (CLMC) or in essential situations the University Level Monitoring Committee (ULMC) in a time period as specified by these bodies.
9. Regarding evaluation, one credit will be evaluated for 20 marks in a semester; thus, a 4-credit course will be evaluated for 80 marks, and 3-credit courses for 60 marks. However, any changes to this if brought by the University will be followed.
10. The duration of the end semester examination of a course with 4 credits will be 2 hours and the same for a course with 3 credits may be 1.5 hours/2 hours.

Mark Distribution Table

Course	Credit		Marks		Lecture			Practical		
	Lecture	Practical	Lecture	Practical	CCA (30%)		ESE (70%)	CCA (40%)		ESE (60%)
					SA (50%)	FA (50%)		SA (50%)	FA (50%)	
4 credit courses	4	0	80	0	12	12	56	0	0	0
	3	1	60	20	9	9	42	4	4	12
	2	2	40	40	6	6	28	8	8	24
	1	3	20	60	3	3	14	12	12	36
	0	4	0	80	0	0	0	16	16	48
	Credits		Marks		Lecture			Practical		
	Lecture	Practical	Lecture	Practical	CCA (30%)		ESE (70%)	CCA (40%)		ESE (60%)
3 credit courses					SA (50%)	FA (50%)		SA (50%)	FA (50%)	
	3	0	60	0	9	9	42	0	0	0
	2	1	40	20	6	6	28	4	4	12
	1	2	20	40	3	3	14	8	8	24
	0	3	0	60	0	0	0	12	12	36

Letter Grades and Grade Point

1. A mark system is followed to evaluate each question. For each course in the semester, letter grades and grade points are introduced in a 10-point indirect grading system as per the guidelines given below.

2. The Semester Grade Point Average (SGPA) is computed from the grades to measure the student's performance in a given semester. The SGPA is based on the current term's grades, while the Cumulative Grade Point Average (CGPA) is based on the grades in all courses taken after joining the programme of study.
3. The weighted grade point will be mentioned in the student's final grade cards, issued by the college, based on the marks obtained.
4. **The grades and grade points will be given as per the following format:**

Letter Grade	Grade Point	Percentage of marks (X) (CCA + ESE together)	Class
O (Outstanding)	10	$X \geq 95\%$	FIRST CLASS WITH DISTINCTION
A+ (Excellent)	9	$85\% \leq X < 95\%$	
A (Very Good)	8	$75\% \leq X < 85\%$	
B+ (Good)	7	$65\% \leq X < 75\%$	FIRST CLASS
B (Above Average)	6	$55\% \leq X < 65\%$	
C (Average)	5	$45\% \leq X < 55\%$	SECOND CLASS
P* (*Pass*)	4	$35\% \leq X < 45\%$	THIRD CLASS
F (Fail)	0	X< 35%	FAIL
Ab (Absent)	0		FAIL

- For a course PASS, separate minimum of 35% is needed for CCA and ESE.
- Less than 35% in either ESE or CCA is FAIL.

Computation of SGPA and CGPA

SGPA (Semester Grade Point Average) and CGPA (cumulative Grade Point Average) will be computed as follows:

1. $$S_j = \frac{\sum(C_{ij} \times G_{ij})}{\sum C_{ij}}$$
   where S_j is the SGPA in the jthsemester,
   C_{ij} is the number of credits for the ith course in the jthsemester, and
   G_{ij} is the the grade point scored by the student in the ith course in the jthsemester.
2. The CGPA is also calculated in the same manner considering all the courses undergone by a student over all the semesters of a programme. That is,
   $$CGPA = \frac{\sum(C_i \times S_i)}{\sum C_i}$$
   where $S_i$is the SGPA in the ithsemester and
   $\sum C_i$ is the total number of credits in the ith semester
3. The SGPA and CGPA shall be rounded to 2 decimal points and reported in the transcripts
4. **Requirement for the successful completion of a Semester**: SGPA of 4 or above and a PASS in all the courses, that is, minimum total of 35% mark in each course (CCA + ESE), with a separate minimum of 35% mark for both CCA and

ESE. Appropriate and permissible rules of rounding off numbers may be adopted as per decisions of the Academic Council.

Chairman
BoS
Computer Science
Mar Ivanios College (Autonomous)
Thiruvananthapuram

10-05-2024

List of Courses

Course Code	Course Title	Course Category	Credits	Hour distribution per week		
				L	T	P
SEMESTER I | Academic Level 100-199						
MIUK1DSCCSA101.1	Data Structures and Algorithms	**DSC**	**4**	**3**	**-**	**2**
MIUK1MDCCSC100.1	Essentials of Digital Technology	**MDC**	**3**	**3**	**-**	**-**
SEMESTER II | Academic Level 100-199						
MIUK2DSCCSA151.1	Introduction To AI	**DSC**	**4**	**3**	**-**	**2**
MIUK2MDCCSC150.1	Philosophy of Computer Science	**MDC**	**3**	**3**	**-**	**-**
SEMESTER III | Academic Level 200-299						
MIUK3DSCCSA201.1	Introduction to Machine Learning	**DSE**	**4**	**3**	**-**	**2**
SEMESTER IV | Academic Level 200-299						
MIUK4DSECSA251.1	Python Programming	**DSE**	**4**	**3**	**-**	**2**
SEMESTER V | Academic Level 300-399						
MIUK5DSECSA301.1	Reinforcement Learning	**DSE**	**4**	**3**	**-**	**2**
SEMESTER VI | Academic Level 300-399						
MIUK6DSECSA351.1	Deep Learning	**DSE**	**4**	**3**	**-**	**2**

Mar Ivanios College (Autonomous)

Discipline	**COMPUTER SCIENCE**				
Course Code	MIUK1DSCCSA101.1				
Course Title	**Data Structures and Algorithms**				
Type of Course	**DSC**				
Semester	I				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Basic understanding of programming in C				
Course Summary	The goal of this course is to give students a thorough understanding of basic data structures, which are crucial elements of computer science. It provides a strong foundation to students in design and analysis of computer algorithms.				

Detailed Syllabus:

Module	Unit	Content	Hrs	CO
I	**Introduction**		**9**	**1**
	1	Basic Terminology, Classification of Data Structures, Operations on Data Structures, Abstract Data Type, Algorithms, Different Approaches to Designing an Algorithm, Control Structures Used in Algorithms, Time and Space Complexity, Big O Notation		
	2	**Searching** - linear search and Binary Search		
II	**Linear Data Structures**		**9**	**2**
	3	**Stack** - Stack ADT, Operations on Stack, Applications of Stack, Infix to postfix conversion, evaluation of expression.		
	4	**Queue** - Queue ADT, Operations on Queue, Circular Queue, Applications of Queue		
	5	**Linked Lists** - Concept of static versus dynamic data structures, operations, types of linked lists , comparison between arrays and linked lists.		
III	**Non Linear Data Structures**		**9**	**2,4**
	6	**Trees** - Basic Terminology, Binary Trees,		

		Representation of Binary Trees, Traversal, Types of Binary Trees.		
	7	**Graphs** - Graph Terminology, Representation of Graphs, Traversal of a Graph, Spanning Trees		
IV	**Graph Algorithms and Techniques**		**9**	**3,5**
	8	Greedy Strategy: Knapsack Problem, Minimal Spanning Tree Algorithms- Prim's and Kruskal's Algorithm,		
	9	Dynamic Programming: Principle of Optimal Substructure, All Pairs shortest path problem, Travelling Salesman Problem, Bellman-Ford Algorithm Backtracking: Control Abstraction, N-Queens problem, Sum of Subsets Problem		
V	**Complexity theory and sorting algorithms**		**9**	**2**
	10	Complexity Theory: Class P and NP, Polynomial time reductions, Class NP Hard and NPComplete, Example Problems- Vertex Cover problem, Clique Problem. Sorting algorithms: Merge sort , quick sort		
Text Books and Materials	Books, Articles, Readings, Software, Websites, Tutorials	**Books:** **1.** Reema Thareja, Data Structures Using C 3rd Edition, Oxford University Press. – Unit 1. **2.** Thomas H. Cormen, et al., "Introduction to Algorithms", Prentice Hall, 3rd Edition (2010) **3.** Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", Orient Longman, Universities Press, 2nd Edition (2008) **Websites:** **1.** https://www.geeksforgeeks.org/learn-data-structures-and-algorithms-dsa-tutorial/		

Lab Exercises:

1. Implementation of linear search algorithm.
2. Utilizing binary search algorithm to search for elements in a sorted array.
3. Implementing basic stack operations such as push, pop, and peek.
4. Evaluating arithmetic expressions using a stack data structure.
5. Converting infix expressions to postfix notation using stack operations.
6. Implementing queue operations like enqueue and dequeue.
7. Implementation of circular queue data structure.
8. Manipulating linked lists, including insertion, deletion, and traversal.
9. Traversing trees, such as in-order, pre-order, and post-order traversal.
10. Traversing graphs, including depth-first and breadth-first traversal algorithms.
11. Implementing quick sort and merge sort algorithms.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Builds the ability to analyze and implement fundamental algorithms and perform searching and sorting.	An, c	PSO-2,4,5
CO-2	Apply linear and non-linear data structures to problem-solving and Describe the fundamental concepts of Computational Complexity	U, A	PSO-3
CO-3	Explain the concepts of Greedy Strategy and Dynamic Programming to use it in solving real world problems.	U, A	PSO-3
CO-4	Gain a deep understanding of tree and graph data structures, including their properties, definitions, and classifications.	U, A	PSO-4
CO-5	Develop problem-solving skills by applying graph algorithms to solve complex problems, such as finding the shortest path in a graph	An	PSO-5

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	CO1	PSO2,	An, C	P	L	
2	CO2	PSO2,3, 4	U, Ap	C	L	P
3	CO3	PSO2,3, 5	U, An	C	L	
4	CO4	PSO2,4, 5	U	C	L	
5	CO5	PSO2, PSO5	An, Ap	P	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO 1		3				
CO 2		2	3	1		
CO 3		2	1		3	
CO 4		1		3	2	
CO 5		2			3	

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	-	-	2	2	-
CO2	3	2	-	-	2	2	-
CO3	3	3	-	-	2	2	-
CO4	3	2	-	-	2	2	-
CO5	3	3	-	-	3	3	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	**Assignment**	**Project Evaluation**	**End Semester Examinations**
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓			✓
CO 6	✓	✓		✓

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Mar Ivanios College (Autonomous)

Discipline	**COMPUTER SCIENCE**				
Course Code	**MIUK1MDCCSC100.1**				
Course Title	**ESSENTIALS OF DIGITAL TECHNOLOGY**				
Type of Course	**MDC**				
Semester	**1**				
Academic Level	**1**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 hours	-	-	3 hours
Pre-requisites	Basic computer skills, critical thinking, and curiosity are key! No prior expertise needed, just a desire to explore the exciting world of digital technology.				
Course Summary	This course explores advanced topics in Information Technology, covering data management, social informatics, IT applications, specific areas like bioinformatics and geoinformatics, futuristic IT such as artificial intelligence, and social impacts. Understand IT strategies like disaster recovery, cloud computing, and green computing. Gain insights into the digital economy, communication models, business governance, and various information systems.				

Detailed Syllabus:

Module	Unit	Content	Hrs	CO
I	**Digital Knowledge Management and Social Informatics**		**9**	CO1
	1	**Knowledge Skills**: Data, Types of Data, Information and Knowledge, Knowledge management, Internet as a knowledge repository, Open access initiatives, IPR copyright and patents, Software licence agreement.	4 hrs	
	2	**Social Informatics**: Digital Society, Digital Divide, Social networks, IT- New threats, Cyber Security, Harsh realities,	5 hrs	

		Guidelines for proper usage, E-Waste, Green computing, Free software Debate.		
II	**IT Applications**		**9**	CO2
	3	**IT Applications:** E-Governance, Overview of IT applications, IT for disabled.	4 hrs	
	4	**Specific areas:** Bio-Informatics (computational biology and bio-informatics) Scope, importance and applications), Immuno-informatics, Geo-informatics (Applications, GIS, Remote sensing, GPS, Web mapping)	5 hrs	
III	**Futuristic IT and Social Impacts**		**9**	CO3
	5	**Futuristic IT:** Artificial Intelligence, Virtual reality, Expert systems, DNA barcoding, DNA fingerprinting, Biocomputing, Biometrics.	6 hrs	
	6	**Social impacts of IT:** Introduction, Privacy, security and integrity of information, IPR, Career in IT	3 hrs	
IV	**IT in the Digital Economy and Strategies**		**9**	CO4
	7	**IT & Digital Economy:** Digital Enterprise, Digital Economy, New Communication models, New Business models, New Governance Models. What is an Information system? Types of Information systems	5 hrs	
	8	**IT Strategies:** Disaster Recovery planning, Cloud computing, Green computing, Offshore outsourcing	4 hrs	
V	**IT Networks and Wireless Communication**		**9**	CO5
	9	**IT Networks:** Communication systems, Data Transmission Channels, Networking Devices, Network types based on topology and graphical scope, Network Protocols and the OSI Communication Model	6 hrs	
	10	Wireless networks, Communication Service Providers and their services	3 hrs	
Text Books and Materials	Books, Articles, Readings, Software, Websites, Tutorials	**Books:** 1. **Chapters 2-6** of Vijayakumaran Nair K, Vinod Chandra S S, Informatics, PHI, 2014 2. **Chapter 1, 18** of Introduction to Information Technology, V.Rajaraman, PHI, Third Edition, 2018 3. **Chapter 1, 2, 7 & 13** of Information Technology, Pradeep K.		

		Sinha, Priti Sinha, PHI, 2017

Course Outcomes

CO	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO1	Develop understanding of data types, knowledge management, digital society, cyber security, and ethical computing.	R, U	PSO2
CO2	Comprehend IT applications including e-governance, bioinformatics, immuno-informatics, and geo-informatics for diverse fields.	R, U	PSO2
CO3	Review futuristic IT concepts and social impacts including AI, VR, biometrics, privacy, and career prospects.	R, U	PSO2
CO4	Comprehend IT's role in digital economy, information systems, strategies like cloud computing, and outsourcing.	R, U	PSO2
CO5	Explain IT networks, protocols, wireless tech, and services offered by communication providers.	R, U	PSO2

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: Essentials of Digital Technology

Credits: 3:0:0 (Lecture:Tutorial:Practical)

COs	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L) / Tutorial (T)	Practical (P)
CO1	PO1, PO2, PO5, PSO2	U	F	L	
CO2	PO1, PO2, PO5, PSO2	U	F	L	
CO3	PO1, PO2, PO5, PSO2	U	F	L	
CO4	PO1, PO2, PO5, PSO2	U	F	L	
CO5	PO1, PO2, PO5, PSO2	U	F	L	

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	-	3	-	-	-	-
CO2	-	3	-	-	-	-
CO3	-	3	-	-	-	-
CO4	-	3	-	-	-	-
CO5	-	3	-	-	-	-

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	3	-	-	3	-	-
CO 2	3	3	-	-	3	-	-
CO 3	3	3	-	-	3	-	-
CO 4	3	3	-	-	3	-	-
CO 5	3	3	-	-	3	-	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	**Assignment**	**Project Evaluation**	**End Semester Examinations**
CO1	✓			✓
CO2	✓			✓

CO3	✓	✓		✓
CO4	✓	✓		✓
CO5		✓		

Mar Ivanios College (Autonomous)

SEMESTER II

Discipline	**COMPUTER SCIENCE**				
Course Code	MIUK2DSCCSA151.1				
Course Title	**INTRODUCTION TO AI**				
Type of Course	**DSC**				
Semester	II				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2	5
Pre-requisites					
Course Summary	This Introduction to Artificial Intelligence course covers the fundamentals of AI, including its history, key technologies like machine learning and natural language processing, and applications across industries such as healthcare, finance, and transportation. It focuses on the features of knowledge based systems and various searching algorithms used.				

Detailed Syllabus:

Module	Unit	Content	Hrs	CO
I	**INTRODUCTION TO ARTIFICIAL INTELLIGENCE**		**9**	**1**
	1	Introduction to Artificial Intelligence, Background and Applications, Turing Test and Rational Agent approaches to AI. Knowledge: Introduction, Definition and Importance of Knowledge, Knowledge–Based Systems, Representation of Knowledge, Knowledge Organization, Knowledge Manipulation, Acquisition of Knowledge.	9	
II	**PREPOSITIONAL AND PREDICATE LOGIC**		**9**	**2**
	2	Propositional logic and predicate logic - Propositional and predicate logic - Syntax - Informal and formal semantics -Forward Chaining, Backward Chaining, Resolution Principle; Structured Knowledge: Associative Networks, Frame Structures, Conceptual Dependencies and Scripts.	9	
III	**SEARCHING ALGORITHMS**		**9**	**4**

	3	State Space Search: Depth First Search, Breadth First Search, Depth First Iterative Deepening, Heuristic Search: Best First Search, Hill Climbing, Solution Space, TSP, Escaping Local Optima, Stochastic Local Search. Population Based Methods: Genetic Algorithms. Finding Optimal Paths: Branch & Bound, A*, Admissibility of A*, Informed Heuristic Functions.	6 3	
IV	**CONCEPTS ON PLAYING GAMES**		**9**	**3**
	4	Game Theory, Board Games and Game Trees, Algorithm Minmax, AlphaBeta and SSS*, Automated Planning: Domain Independent Planning, Blocks World, Forward & Backward Search, Goal Stack Planning, Plan Space Planning.	9	
V	**APPLICATIONS AND TECHNOLOGIES IN AI**		**9**	**5**
	5	AI in healthcare: Diagnosis, treatment, and medical imaging, AI in finance: Fraud detection, algorithmic trading, and risk assessment, AI in transportation: Autonomous vehicles and traffic optimization, AI in customer service and chatbots, AI in education: Personalized learning and intelligent tutoring systems Machine learning concepts, Deep learning and neural networks, Natural language processing (NLP) and computer vision	7 2	
Text Books and Materials	Books, Articles, Readings, Software, Websites, Tutorials	**Books:** 1.Russell, Norvig, *Artificial Intelligence: A Modern Approach*, Third edition, Prentice Hall, 2010. 2. Gendreau, Michel, and Jean-Yves Potvin, *Handbook of metaheuristics*, Springer, 2010. 3. Artificial Intelligence Theory, Models, and Applications Unknown Binding, P Kaliraj (Editor), T. Devi (Editor), 2021, CRC Press **Websites:** 1. https://ai.google/ 2. https://learn.microsoft.com/en-us/ai/		

Lab Exercises

1. Create a program that explores various uninformed search strategies such as breadth-first and depth-first searches. Analyze their efficiency and effectiveness in different scenarios.
2. Develop a program that utilizes informed search strategies like A* or Greedy Best-First Search.

3. Construct a knowledge base using propositional and predicate logic.
4. Design an ontology for a specific domain and illustrate how it can be used to enhance knowledge representation and retrieval in AI systems.
5. Write a program that uses scripts and frames to represent complex scenarios.
6. Develop an expert system that uses forward and backward chaining to solve problems.
7. Construct a Bayesian network for a given dataset and implement a program that performs inference to predict outcomes under uncertainty.
8. Create a decision tree algorithm to classify data.
9. Write a program that uses the Rete algorithm

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand formal methods of knowledge representation.	U	PSO 2
CO-2	Understand foundational principles, mathematical tools and program paradigms of AI.	U, An, Ap	PSO 2, 3
CO-3	Apply problem solving through search for AI application like playing games.	An, Ap	PSO 3, 5
CO-4	Evaluate the performance of various searching algorithms.	An, E	PSO 2, 3, 5
CO-5	Identify and analyse the diverse applications of AI, ranging from healthcare and finance to transportation, customer service, and education, thereby enabling them to understand the impact of AI across various sectors	U, An	PSO2, 5

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create
Note: 1 or 2 COs/module

Name of the Course: INTRODUCTION TO AI
Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	CO1	PSO 2	U	C, F	L	
2	CO2	PSO 2 PSO 3	U, An, Ap	C, M	L	
3	CO3	PSO 3, PSO 5	An, Ap	P	L	
4	CO4	PSO 2,3,5	An, E	P	L	
5	CO5	PSO 2,5	U, An	C	L	

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO 1		3				
CO 2		2	3			
CO 3			2		3	
CO 4		2	3		1	
CO 5		1			3	

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	-	-	3	2	-
CO2	3	3	-	-	3	2	-
CO3	3	3	-	-	2	2	-
CO4	3	3	-	-	3	2	-
CO5	3	3	-	-	2	2	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO	✓	✓		✓

1				
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓			✓
CO 5	✓			✓
CO 6	✓	✓		✓

Mar Ivanios College (Autonomous)

Discipline	**COMPUTER SCIENCE**				
Course Code	**MIUK2MDCCSC150.1**				
Course Title	**PHILOSOPHY OF COMPUTER SCIENCE**				
Type of Course	**MDC**				
Semester	**II**				
Academic Level	**100-199**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 hours	-	-	3 Hours
Pre-requisites					
Course Summary	Explore the intersection of philosophy and computer science in this dynamic course. Develop critical thinking skills through philosophical inquiry while gaining a solid foundation in computer science, engineering principles, and practical software development. The course emphasizes ethical considerations, preparing students for diverse challenges in both fields.				

Detailed Syllabus:

Module	Unit	Content	Hrs	CO
I	**Philosophy and Computer Science**		**9**	CO1
	1	**Philosophy:** Introduction, A Definition of 'Philosophy', What Is Truth?, Searching for the Truth, What Is "Rational"?, Philosophy as a Personal Search, Philosophies of Anything and Everything, Philosophy and Computer Science.	4	
	2	**What Is Computer Science?** Introduction, Naming the Discipline, Why Ask What CS Is?, What Does It Mean to Ask What Something Is?, CS as the Science of Computers, CS Studies Algorithms, Physical Computers vs. Abstract Algorithms.	5	
II	**Understanding Science and Engineering in the Context of**		**9**	CO2

	Computer Science			
	3	**Science:** Introduction, Science and Non-Science, Science as Systematic Study, The Goals of Science, Instrumentalism vs. Realism, Scientific Theories, "The" Scientific Method, Falsifiability, Scientific Revolutions, Other Alternatives, CS and Science.	6	
	4	**Engineering:** Defining 'Engineering', Engineering as Science, Brief History of Engineering, Conceptions of Engineering, What Engineers Do? The Engineering Method, Software Engineering, CS and Engineering.	3	
III	**Algorithms, Computability, and the Philosophy of Computers**		**9**	CO3
	5	**Algorithms and Computability,** Introduction, Functions and Computation, 'Algorithm' Made Precise, Five Great Insights of CS, Structured Programming, Recursive Functions, Non-Computable Functions.	6	
	6	**Computers: A Philosophical Perspective,** John Searle's "Pancomputationalism": Everything Is a Computer, What Else Might Be a Computer?.	3	
IV	**Hypercomputation, Software, and Hardware**		**9**	CO4
	7	**Hypercomputation:** Introduction, Generic Computation, Non-Euclidean Geometries and "Non-Turing Computations", Hyper-computation, Interactive Computation, Oracle Computation, Trial-and-Error Computation.	5	
	8	**Software and Hardware:** The Nature of Computer Programs, Programs and Algorithms, Software, Programs, and Hardware, Moor: Software Is Changeable, Suber: Software Is Pattern, Colburn: Software Is a Concrete Abstraction.	4	
V	**Flexi Module: Computer Programs as Scientific Theories and Mathematical Objects**		**9**	CO5
	9	**Computer Programs as Scientific Theories:** introduction, Simulations, Computer Programs Are Theories, Computer Programs Aren't Theories.	4	
	10	**Computer Programs as Mathematical Objects:** Introduction, Theorem Verification, Program Verification, The Fetzer Controversy, Program	5	

		Verification, Models, and the World.		
Text Books and Materials	Books, Articles, Readings, Software, Websites, Tutorials	**Books:** 1. **Chapter 2-5, 7, 9, 11, 12, 14, 15** of William J. Rapaport, Philosophy of Computer Science: An Introduction to the Issues and the Literature, Wiley-Blackwell, 2023		

Course Outcomes

CO	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO1	Gain deep understanding of philosophy's nature, truth, rationality, alongside computer science's foundations and algorithms.	R, U	PSO3
CO2	Explain science's principles, methods, theories, and its relation to engineering and computer science.	R, U	PSO3
CO3	Grasp fundamental concepts of algorithms, computability, and the philosophical perspective on computers.	R, U	PSO3
CO4	Explore advanced topics including hypercomputation, software nature, and the interplay between programs and hardware.	R, U	PSO5
CO5	Evaluate computer programs as scientific theories and mathematical entities, examining verification methods and theoretical controversies.	R, U	PSO2

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: Philosophy of Computer Science

Credits: 3:0:0 (Lecture: Tutorial: Practical)

CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L) / Tutorial (T)	Practical (P)
CO1	PO1, PO2, PO5, PSO3	U	C	L	
CO2	PO1, PO2, PO5, PSO3	U	C	L	
CO3	PO1, PO2, PO5, PSO3	U	C	L	
CO4	PO1, PO2, PO5, PSO5	U	C	L	

CO5	PO1, PO2, PO5, PSO2	U	C	L	

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	-	-	3	-	1	-
CO2	-	1	3	-	1	-
CO3	-	-	3	-	1	-
CO4	-	1	2	-	3	-
CO5	-	3	2	-	1	-

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	-	-	2	-	-
CO2	3	3	-	-	2	-	-
CO3	3	3	-	-	3	-	-
CO4	3	3	-	-	3	-	-
CO5	3	3	-	-	2	-	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO1	✓			✓
CO2	✓			✓
CO3	✓	✓		✓
CO4	✓	✓		✓
CO5		✓		

Mar Ivanios College (Autonomous)

SEMESTERIII

Discipline	**COMPUTER SCIENCE**				
Course Code	MIUK3DSCCSA201.1				
Course Title	**Introduction to Machine Learning**				
Type of Course	**DSC**				
Semester	III				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites					
Course Summary	Explore machine learning fundamentals, AI applications, and data essentials, including architecture, techniques, and tools like Scikit Learn and Pandas.				

Detailed Syllabus:

Module	Unit	Content	Hrs	CO
I	**MACHINE LEARNING DEFINED - ACADEMIC AND INDUSTRY PERSPECTIVE**		**9**	1
	1	Machine Learning Academic and Industry Definition - Features of Machine Learning - Types of Machine Learning - Machine Learning Approaches - Machine Learning Techniques - Features of Machine Learning - Applications of Machine Learning	4	
	2	Artificial Intelligence and Cognitive Technologies - Impact of Cognitive Technologies – Features – Benefits – Growth - Role of Cognitive Technologies in an Enterprise Implementation	5	
II	**MACHINE LEARNING ARCHITECTURE AND REAL WORLD APPLICATIONS**		**9**	**2**
	3	Understanding Machine Learning Architecture - Data Collection - Data Integration - Data Provisioning - Feature Engineering - Understanding Machine Learning Workflow - Problem Statement - Data Engineering - Model Engineering - Model Deployment - AI Applied in Health –	9	

		Case Management Analysis - AI Applied in Health - Care Management Analysis - AI Applied in Health – Patient Readmission Analysis		
III	**EXPLORATION OF MACHINE LEARNING TECHNIQUES AND MODELS**		**9**	**3**
	4	Machine Learning Models – Supervised - Unsupervised - Reinforcement Machine Learning Models.	4	
	5	Introduction to Machine Learning Regression Problems - Introduction to Machine Learning Classification Problems - Difference Between Regression and Classification - Linear Regression - Polynomial Regression - Ridge Regression - Lasso Regression	5	
IV	**CLASSIFICATION IN MACHINE LEARNING: TECHNIQUES,**		**9**	**4**
	6	Classification – Logistic Regression - Naïve Bayes - Random Forest – XGBoost - What Problem Does Machine Learning Solve - Getting Started with Machine Learning Problem Types - Understanding Machine Learning Problem Types - Classification Problems in Machine Learning - List of Classification Models.	9	
V	**DATA COLLECTION AND SOFTWARE ESSENTIALS**		**9**	**5**
	7	Machine Learning Data Requirements - Introduction to Data Collection Strategy - Type of Data needed - Useful Known Features - Source of Data - Amount of Data needed - Quality of Data needed - Permission to Collect and use data -	5	
	8	Understanding the Hardware and software Specifications - Scikit Learn – Numpy – Pandas – SciPy - Matplotlib	4	
Text Books and Materials	Books, Articles, Readings, Software, Websites, Tutorials	**Books:** 1. Introduction to Machine Learning with Python, By Andreas C. Müller and Sarah Guido, October 2016. 2. Essential Machine Learning and Pragmatic AI, By Noah Gift, December 2018 3. Machine Learning Yearning by Andrew Ng, deeplearning.ai, 2018. 4. Hands-On Unsupervised Learning Using Python, By Ankur A. Patel, March 2019. 5. Clustering and Unsupervised Learning, By Angie Ma, Gary Willis and Alessandra Stagliano, August 2017 6. Introduction to Machine Learning, Alex Smola and S.V.N.		

		Vishwanathan **Tutorials:** Stanford Lectures of Andrew Ng.

Lab Exercises

1. Write a Python script to load a dataset and perform basic exploratory data analysis (EDA) using pandas and matplotlib.
2. Implement a simple "Hello World" example of a machine learning algorithm using scikit-learn.
3. Split a dataset into training and testing sets and train a supervised learning model (e.g., linear regression or decision tree).
4. Use clustering algorithms (e.g., K-means) to group data points into clusters without labels.
5. Build a classification model using logistic regression to predict the likelihood of a customer buying a product based on demographic data.
6. Identify and collect relevant datasets for a given machine learning problem statement.
7. Write Python code to scrape data from a website or API using libraries like BeautifulSoup or requests.
8. Handle missing values and perform data imputation techniques to fill in missing data.
9. Analyze a dataset related to healthcare case management and identify key features for predicting patient outcomes.
10. Build and evaluate machine learning models to predict patient case management outcomes (e.g., length of stay or treatment success).
11. Implement a supervised learning algorithm (e.g., decision trees or support vector machines) to predict house prices based on features such as square footage, number of bedrooms, and location.
12. Evaluate the performance of the model using metrics such as mean squared error or accuracy.

Course Outcomes

No.	Upon completion of the course, the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand machine learning principles, applications, and the significance of cognitive technologies	U	PSO2
CO-2	Navigate machine learning architecture, workflow, and its real-world applications.	U	PSO1, PSO4, PSO5
CO-3	Gain expertise in diverse machine learning models (supervised, unsupervised, Reinforcement).	U	PSO2, PSO4
CO-4	Discover basic classification techniques and problem-solving in machine learning	U	PSO3,5
CO-5	Understand data needs, collection strategies, and software specifications for machine learning.	U	PSO2,3,5
CO-6	Gain practical skills in loading, analyzing data, implementing basic machine learning algorithms, data preprocessing, model training, and evaluation.	Ap	PSO3, PSO4, PSO6

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create
Note: 1 or 2 COs/module

Name of the Course: Introduction to Machine Learning
Credits: 3:0:2 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	CO1	PSO2	U	C	L	
2	CO2	PSO1, PSO4, PSO 5	U	C, P	L	
3	CO3	PSO2, PSO4	U	P	L	
4	CO4	PSO3, PSO5	U	P	L	
5	CO5	PSO2,3, 5	U	C	L	
6	CO6	PSO3, PSO4, PSO6	Ap	P		P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1		3					3	1	-	-	3	-	-
CO 2	1			3	2		-	1	-	1	3	-	-
CO 3		2		3			-	2	-	1	1	-	-
CO 4			3		2		3	-	-	2	2	-	-
CO 5		2	3		1		3	-	-	1	-	-	-
CO 6			2	1		2	3	1	-	1	1	-	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		
CO 6	✓	✓		✓

Mar Ivanios College (Autonomous)

SEMESTER IV

Discipline	COMPUTER SCIENCE				
Course Code	MIUK4DSECSA251.1				
Course Title	**Python Programming**				
Type of Course	**DSE**				
Semester	IV				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	A basic understanding of fundamental programming concepts and familiarity with basic computer skills can enhance the learning experience.				
Course Summary	This course is designed to provide students with an overview of the various tools available for writing and running Python. It aims to get students coding quickly. As Python is the language of choice for data analysts and data scientists, the curriculum covers essential topics on how to use functions, methods, and packages to efficiently leverage the code needed to solve challenging problems.				

Detailed Syllabus:

Module	Unit	Content	Hrs	CO
I		**INTRODUCTION TO PYTHON**	**12**	
	1	Features of Python, How to run Python, Identifiers, Reserved Keywords, Variables, Comments, Indentation, Input, Output and Import Functions, Operators. **Data Types and Operations** - Numbers, Strings, List, Tuple, Set, Dictionary, Mutable and Immutable Objects, Data Type Conversion.	6	CO1, CO2
	2	**Decision Making** – if statement, if..else statement, if…elif…else statement, Nested if statement. **Loops** - for loop, range() function, for loop with else statement, while loop, while loop with else statement. **Control Statements** - break Statement, continue statement, pass statement.	6	
II		**FUNCTIONS AND FUNCTION ARGUMENTS**	**6**	
	3	Definition, Function Calling. **Functions Arguments** - Required arguments, Keyword arguments, Default arguments, Variable-Length arguments. **Anonymous Functions (Lambda Functions)** - filter() function, reduce() function, Recursive Functions.	6	CO2
III		**MODULES, PACKAGES, FILE HANDLING**	**7**	
		Modules & Packages - Built-in Modules, Creating Modules, import statement, locating		

	4	modules, Namespaces and Scope, dir (), reload (), Packages in Python. **File Handling**- Open, Close, Write, Read, File methods, Rename, Delete. Directories in Python.	7	CO3
IV	**OBJECT ORIENTED PROGRAMMING IN PYTHON**		**8**	
	5	Class, Objects, Methods, Attributes, Destructor, Encapsulation, Data hiding. **Exception handling**- built in exceptions, Handling, Exception with arguments, Raising and User defined exceptions, Assertions in Python.	8	CO3
V	**GUI AND DATABASE PROGRAMMING**		**12**	
	6	**Regular expressions** – match, search, replace, patterns. **GUI programming** – Introduction, Tkinter Widgets. **Database Programming**- Establishing Connection, insert, retrieve, delete, rollback and commit operations.	12	CO4
Text Books and Materials	Books, Articles, Readings, Software, Websites, Tutorials	**Books:** Jeeva Jose, *Taming PYTHON By Programming*, Khanna Publications, 2017. **Websites:** https://www.w3schools.com/python/ https://www.programiz.com/python-programming		

Lab Exercises:

1. Programs based on Python data structures- List, Set, Tuple, Strings.
2. Programs involving flow control statements.
3. Build the Programs using functions and recursive functions.
4. Programs on Modules and Packages.
5. Programs based on files.
6. Demonstrate classes and objects.
7. Programs on exception handling.
8. Create programs on regular expressions.
9. Programs using Tkinter widgets.
10. Develop programs on database.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements and functions.	R, U	PSO2
CO-2	Determine the methods to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples and sets.	U, Ap	PSO2, PSO3
CO-3	Articulate the object-Oriented Programming concepts and identify the commonly used operations involving file systems and Exception handling.	Ap	PSO4, PSO5
CO-4	Implement regular expressions in exemplary applications related to Web services and Databases in Python.	C	PSO5, PSO6
CO-5	Create diverse Python programs using different programming concepts	C	PSO-3,4,5

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create
Note: 1 or 2 COs/module
Name of the Course: Python programming
Credits: 3:0:2 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	CO1	PSO2, PSO3	R, U	F, C	L	
2	CO2	PSO2, PSO3, PSO4	U, Ap	C, P	L	
3	CO3	PSO3, PSO4, PSO5	Ap	C, P	L	
4	CO4	PSO3, PSO4, PSO5, PSO6	C	P	L	
5	CO5	PSO3, PSO4, PSO5	C	P, M		P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive
Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO 1	-	1	2	-	-	-
CO 2	-	1	2	3	-	-
CO 3	-	-	2	3	3	-
CO 4	-	-	2	3	3	3
CO 5	-	-	2	3	3	-

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	-	-	3	2	-
CO2	3	3	-	-	3	2	-
CO3	3	3	-	-	2	2	-
CO4	3	3	-	-	3	3	-
CO5	3	3	-	-	3	3	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓

Mar Ivanios College (Autonomous)

SEMESTER V

Discipline	**COMPUTER SCIENCE**				
Course Code	MIUK5DSECSA301.1				
Course Title	**Reinforcement Learning**				
Type of Course	**DSE**				
Semester	V				
Academic Level	300-399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Solid foundation in machine learning and programming, particularly in Python				
Course Summary	Provides a comprehensive understanding of Reinforcement Learning, covering foundational concepts, advanced algorithms, and real-world applications, equipping students with both theoretical knowledge and practical skills in this dynamic field of AI				

Detailed Syllabus:

Module	Unit	Content	Hrs	CO
I	**INTRODUCTION TO REINFORCEMENT LEARNING**		**9**	1
	1	Definitions and Scope of RL - Components of an RL Agent - Reinforcement Learning for AI - Use and applications of RL - The RL Framework: Rewards, States, and Actions - Overview of Markov Decision Processes (MDPs) - Goals and Objectives of RL		
II	**EXPLORATION AND EXPLOITATION**		**9**	**2**
	2	Understanding Policy and Value Functions - The Bellman Equations for Value Iteration - Balancing Exploration and Exploitation - Multi-Armed Bandits and Bandit Algorithms - Epsilon-Greedy and Softmax Strategies.		
III	**LEARNING AND PLANNING**		**9**	**3**
	3	Basics of Dynamic Programming in RL - Temporal Difference (TD) Learning: TD(0)		

		and TD(λ) - Introduction to Q-Learning - SARSA: On-policy TD Control - Differences between Model-based and Model-free RL.		
IV	**FUNCTION APPROXIMATION AND CONTROL**		**9**	**4**
	4	Linear Function Approximation - Nonlinear Function Approximation: Neural Networks - Deep Q-Networks (DQN) and its Variants - Policy Gradient Methods: REINFORCE - Actor-Critic Methods: A3C and A2C.		
V	**ADVANCED RL**		**9**	**5**
	5	Current trends and future directions in RL - **Recommender Systems** - RL in personalization algorithms - RL applications in robotics - RL in self-driving car decision-making - Ethical implications of RL - Responsible AI and societal impact.		
Text Books and Materials	Books, Articles, Readings, Software, Websites, Tutorials	**Books:** 1. *Reinforcement Learning: An Introduction* by Richard S. Sutton and Andrew G. Barto, MIT Press, Second edition, 2018.		

Lab Exercise

Lab 1: Introduction to RL Environments

- **Question:** How does the agent interact with the environment in OpenAI Gym?
- **Tools:** Python, OpenAI Gym library

Lab 2: Implementing Simple Bandit Algorithms

- **Question:** Implement and compare the performance of different bandit algorithms on a simulated slot machine.
- **Tools:** Python, NumPy library

Lab 3: Dynamic Programming in Gridworld

- **Question:** How would you apply value iteration to find the optimal policy in a Gridworld environment?
- **Tools:** Python, Matplotlib for visualization

Lab 4: Temporal Difference Learning

- **Question:** Implement TD(0) for policy evaluation and demonstrate its convergence.
- **Tools:** Python, Jupyter Notebook for iterative development

Lab 5: Q-Learning in a Maze

- **Question:** Develop a Q-Learning agent to navigate a maze and reach a goal state.
- **Tools:** Python, OpenAI Gym for the maze environment

Lab 6: SARSA vs. Q-Learning

- **Question:** Compare the learning curves of SARSA and Q-Learning in a simple environment.
- **Tools:** Python, OpenAI Gym, Matplotlib for plotting results

Lab 7: Function Approximation

- **Question:** How does function approximation improve the scalability of RL algorithms?
- **Tools:** Python, Scikit-learn for linear models

Lab 8: Deep Q-Networks (DQN)

- **Question:** Implement a DQN to play a simple video game and analyze its performance.
- **Tools:** Python, TensorFlow or PyTorch, OpenAI Gym

Lab 9: Hierarchical RL

- **Question:** Design a hierarchical agent and explain how it solves complex tasks more efficiently.
- **Tools:** Python, TensorFlow, or PyTorch

Lab 10: Multi-agent RL

- **Question:** Set up a cooperative multi-agent scenario and observe the emergent behaviors.
- **Tools:** Python, OpenAI Gym, Multi-agent reinforcement learning framework

Lab 11: Exploration Strategies

- **Question:** Experiment with different exploration strategies and measure their impact on learning.
- **Tools:** Python, OpenAI Gym, NumPy for statistical analysis

Lab 12: Current Research in RL

- **Question:** Replicate an experiment from a recent RL research paper and discuss the results.
- **Tools:** Python, relevant RL libraries/frameworks, research paper for reference

Course Outcomes

No.	Upon completion of the course, the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand the foundational principles of RL and its role in AI and be able to formulate problems as MDPs and apply basic RL algorithms.	U, Ap	PSO2, PSO3, PSO5
CO-2	Gain proficiency in implementing bandit algorithms and understanding their applications.	Ap	PSO4, PSO5
CO-3	Able to design and evaluate model-based and model-free RL algorithms.	Ap, An	PSO3, PSO5
CO-4	Develop skills in function approximation for RL and implement advanced algorithms like DQN and understand policy gradient methods	Ap, U, An	PSO3, PSO5, PSO6
CO-5	Explore cutting-edge RL topics and their real-world applications and also be prepared to engage with current research and contribute to the field of RL	U, E, C	PSO2, PSO3, PSO5, PSO6
CO-6	Able to implement and analyze reinforcement learning algorithms in simulated environments	Ap, An	PSO1, PSO3, PSO4, PSO5.

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Reinforcement Learning

Credits: 3:0:2 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	CO1	PSO2, PSO3, PSO5	U, Ap	C, P	L	
2	CO2	PSO4, PSO5	Ap	P	L	
3	CO3	PSO3, PSO5	Ap,An	P,C	L	
4	CO4	PSO3, PSO5, PSO6	Ap, U, An	P, C	L	
5	CO5	PSO2, PSO3, PSO5, PSO6	U, E, C	C, M	L	
6	CO6	PSO1, PSO3, PSO4, PSO5.	Ap, An	P, M		P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO 1	1	-	-	-	-	-
CO 2	2	3	-	-	-	-
CO 3	-	-	1	-	-	-
CO 4	-	-	2	3	-	-
CO 5	-	1	-	-	-	-
CO 6	-	-	-	3	-	-

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	-	-	3	-	-
CO2	2	1	-	-	3	-	-
CO3	1	-	-	-	2	-	-
CO	-	1	-	-	2	-	-

4							
CO 5	2	-	-	-	2	-	-
CO 6	2	1	-	-	2	-	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	**Assignment**	**Project Evaluation**	**End Semester Examinations**
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		
CO 6	✓	✓		✓

Mar Ivanios College (Autonomous)

SEMESTER VI

Discipline	**COMPUTER SCIENCE**				
Course Code	MIUK6DSECSA351.1				
Course Title	**Deep Learning**				
Type of Course	**DSE**				
Semester	VI				
Academic Level	300-399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Basic understanding of machine learning concepts, and familiarity with programming languages such as Python.				
Course Summary	Acquire expertise in all aspects of deep learning, including fundamental theories, workflow strategies, architectural implementations, neural network insights, concepts of generative AI, and hardware integration.				

Detailed Syllabus:

Module	Unit	Content	Hrs	CO
I	**FOUNDATIONS AND APPLICATIONS OF DEEP LEARNING**		**9**	1
	1	Deep Learning defined from Academic and industry perspective - Functions of a deep learning system - How a business uses deep learning - How deep learning works? - Deep Learning Architecture - Deep Learning Libraries - Deep Learning Implementation Framework.	4	
	2	The core of deep learning: ANN - Role of deep neural networks - Deep learning and machine learning - Deep learning vs Data Science - Teaching artificial neurons unknown functions - Error measurement in neural networks - Gradient descent - Loss functions - Learning rates.	5	
II	**DEEP LEARNING IMPLEMENTATION PIPELINE**		**9**	**2**
	3	Deep Learning Workflow - Steps in Deep Learning in Implementation - Data	9	

		Collection - Public Datasets - Existing Databases - Data Preparation - Cleaning Data - Feature Scaling - Handling categorical data & text - Model Engineering - Test Train Split - Handling Imbalanced Data - Model Training - Model Validation - Model Test - Model Outcome - Model Accuracy - Tune Hyperparameters - Deploy Model - Monitor Predictions - Manage your models.		
III	**DEEP LEARNING ARCHITECTURES AND IMPLEMENTATION FRAMEWORKS**		**9**	**3**
	4	Deep Learning Architectures - Components of a deep learning solution - Data Generation, Collection, Training, Evaluation - Task Orchestration – Prediction.	4	
	5	Deep Learning Implementation Framework - Features of a good deep learning framework - Popular deep learning frameworks.	5	
IV	**NEURAL NETWORKS: FROM BIOLOGICAL TO ARTIFICIAL AND GENERATIVE AI**		**9**	**4**
	6	Neural Networks: An Overview - Biological Neural Networks - Artificial Neural Networks: Neurons – Connections – Learning rule. Deep Neural Networks: Classification: models - Convolutional Neural Networks - Regression: Artificial Neural Networks	7	
	7	Introduction to Generative AI – DALL E2, DALL E3.	2	
V	**DATA STRATEGY TO HARDWARE IMPLEMENTATION:**		**9**	**5**
	8	Supervised Models - Unsupervised Models - Data Collection strategy for ML - How much data is needed - Is your data good enough? - Data Structure.	4	
	9	Building a Deep Learning Hardware system – Benefits – Challenges - Choosing the hardware components (GPU, TPU) - Choosing the software components - Choosing the OS - Adding Packages - Customer Churn - Who is going to churn? - When the churn will occur - Why(reason) is the churn occurring.	5	
Text Books and Materials	Books, Articles, Readings, Software, Websites,	**Books:** 1. Deep Learning from Scratch, by Seth Weidman, Released September 2019, Publisher(s): O'Reilly Media, Inc. 2. Introduction to Deep Learning, Book by Eugene Charniak 3. Deep Learning: A Practical Approach, PB Paperback – 1		

	Tutorials	January 2018 by Rajiv Chopra.

Lab Exercises:

1. Build a simple artificial Neural Network with 1 layer, with 1 neuron, and the input shape equal to 1, feed some data, use the equation y=5x-3, where x = -2, y=-4, and train the network.
2. Using Tensorflow Build a network with a single hidden layer and at least 300,000 trainable parameters
3. Using Tensorflow build 3 networks, each with at least 10 hidden layers such that:
   - The first model has fewer than 10 nodes per layer.
   - The second model has between 10-50 nodes per layer.
   - The third model has between 50-100 nodes per layer.
4. Build a network with at least 3 hidden layers that achieve better than 92% accuracy on validation and test data. You may need to train for more than 10 epochs to achieve this result.
5. Build a network for classification using the built-in MNIST dataset.
6. Build a network for classification using the built-in MNIST dataset and Use the sigmoid activation function.
7. Conduct an experiment on Object detection using a Convolution Neural Network.
8. Build a Recommendation system using Deep Learning techniques.
9. Use Recurrent Neural Network to Perform Sentiment Analysis.
10. Using Generative Adversarial networks performs Image generation.
11. Deep Learning Hands-On Lab Work - Build, Test, and Deploy ML Models.

Course Outcomes

No.	Upon completion of the course, the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Get Hands-on Knowledge, Skills, and Expertise to define deep learning from both the academic and industry perspective and all the related concepts	U	PSO2, PSO5
CO-2	Adopt the best strategies for deep learning data collection, pre-processing, and model engineering tasks	Ap	PSO3, PSO5
CO-3	Gain a comprehensive understanding of deep learning architectures and implementation frameworks	U	PSO2, PSO5
CO-4	Get to know all the deep learning models involved in building deep learning applications	U, Ap	PSO2, PSO5
CO-5	Understand all the data software, and hardware requirements for building deep learning models	U	PSO1, PSO4, PSO5
CO-6	Get Hands-on Knowledge, Skills, and Expertise in a real-world use case implementation	Ap	PSO1, PSO4, PSO6

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Deep Learning

Credits: 3:0:2 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	CO1	PSO2, PSO5	U	C	L	
2	CO2	PSO3, PSO5	Ap	P	L	
3	CO3	PSO2, PSO5	U	C	L	
4	CO4	PSO2, PSO5	U, Ap	C	L	
5	CO5	PSO1, PSO4, PSO5	U	C	L	
6	CO6	PSO1, PSO4, PSO6	Ap	P		P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO 1	1	-	-	-	-	-
CO 2	2	3	-	-	-	-
CO 3	-	-	1	-	-	-
CO 4	-	-	2	3	-	-
CO 5	-	1	-	-	-	-
CO 6	-	-	-	3	-	-

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	-	-	2	-	-
CO2	2	1	-	-	2	-	-
CO3	2	1	-	-	1	-	-
CO4	-	-	-	-	2	-	-
CO5	1	-	-	-	1	-	-
C	1	-	-	-	2	-	-

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Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
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- Programming Assignments
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Mapping of COs to Assessment Rubrics :

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CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		
CO 6	✓	✓		✓