SCHEME OF STUDIES
DIPLOMA IN COMPUTER SCIENCE & ENGINEERING
(C-20)

CURRICULUM STRUCTURE

V Semester Scheme of Studies - Diploma in Computer Science and Engineering [C-20]

Sl. No	Course Category / Teaching Department	Course Code	Pathway Title	Hours per Semester			Total contact hrs	Credits	CIE Marks		SEE Marks				Total Marks	Min Marks for Passing	Assigned Grade		Grade Point	SGPA and
											Theory		Practical							
				L	T	P			Max	Min	Max	Min	Max	Min						
Programme Specialization Pathway																				
1	**CSE** Specialization pathways in emerging areas Student may select any one of the specializations	**20CS51I**	1. Artificial Intelligence and Machine Learning	104	52	312	468	24	240	96	60	24	100	40	400	160				Both SGPA & CGPA
		20CS52I	2. Full Stack Development	104	52	312	468	24	240	96	60	24	100	40	400	160				
		20CS53I	3. Cloud Computing	104	52	312	468	24	240	96	60	24	100	40	400	160				
		20CS54I	4. Cyber Security	104	52	312	468	24	240	96	60	24	100	40	400	160				
Science and Research Pathway																				
	Course Category / Teaching Department	**Course Code**	**Higher Education Pathway**	**Hours per Semester**			**Total contact**	**Credits**	**CIE Marks**		**SEE Marks (Theory)**				**Total Marks**	**Min Marks for Passing**	**Assigned Grade**		**Grade Point**	
				L	T	P			Max	Min	Max		Min							
2	BS/SC Specialization pathway in Science and Research **(Student need to take all four papers in this pathway)**	**20SC51T**	Paper 1 – Applied Mathematics	52	26	0	78	6	50	20	50		20		100	40				
		20SC52T	Paper 2 – Applied Science	52	-	52	104	6	50	20	50		20		100	40				
		20RM53T	Paper 3 – Research Methodology	52	-	52	104	6	50	20	50		20		100	40				
		20TW54P	Paper 4 – Technical Writing	39	13	52	104	6	60	24	40		16		100	40				
			Total	195	39	156	390	24	210	84	190		76		400	160				
Entrepreneurship and Start up Pathway																				
3	**ES/ CSE**	**20ET51I**	Entrepreneurship and Start-up	104	52	312	468	24	240	96	160		64		400	160				

L:- Lecture T:- Tutorial P:- Practical BS- Basic Science:: ES-Engineering Science:: SC: Science , I: Integrated :: CS: Computer Science and Engineering

Note : In 5th Semester student need to select any one of the pathways consisting of 24 credits

VI Semester Scheme of Studies - Diploma in Computer Science and Engineering [C-20]

Pathway	Course Category / Teaching Department	Course Code	Course	Hours per Semester			Total contact hrs	Credits	CIE Marks		SEE Marks		Total Marks	Min Marks for Passing (including CIE marks)	Assigned Grade	Grade Point	SGPA and CGPA
				L	T	P			Max	Min	Max	Min					
Internship/Project																	**Both SGPA & CGPA**
Internshi	ES/CSE	20CS61P	Internship / Project	40 Hours / week Total 16 Weeks			640	16	240	96	160	64	400	160			

P: Project/Internship

Artificial Intelligence
and
Machine Learning

Diploma in Computer Science & Engineering

Program	**Computer Science & Engineering**	**Semester**	**5**
Course Code	**20CS51I**	**Type of Course**	**L:T:P (104:52:312)**
Course Name	**Artificial Intelligence and Machine Learning**	**Credits**	**24**
CIE Marks	**240**	**SEE Marks**	**160**

Introduction:

Welcome to the curriculum for the Artificial Intelligence and Machine Learning (AI&ML) Specialisation. This specialisation course is taught in Bootcamp mode. Bootcamps are 12 weeks, intense learning sessions designed to prepare you for the practical world – ready for either industry or becoming an entrepreneur. You will be assisted through the course, with development-based assessments to enable progressive learning. In this course, you'll learn how to produce a computer-assisted solution when data is too complex for humans to find answers as they combine both data science and machine learning skills that are needed for today's job market.

Some common examples include; Amazon Alexa - converting spoken audio into language; Google Image Search – uses image recognition to return specific search results; Samsung Smart Fridges – uses data and machine learning to produce intuitions about your behaviour. Leading to the successful completion of this bootcamp, you shall be equipped to either do an internship at an organization working in AI or do a project in AI. After the completion of your Diploma, you shall be ready to take up roles like Machine Learning Engineer, Data Scientist, Data Analyst, and more.

This course will teach you Fundamentals of AI, Python and Python libraries, data visualization, machine learning models, maths like linear algebra, data interpretation, deep learning, Version control system, cloud deployment and more. Details of the curriculum is presented in the sections below.

Pre-requisite

Before the start of this specialisation course, you would have completed the following courses;

In the 1st year of study, you would have studied Engineering Mathematics, Communication Skills, Computer Aided Engineering Graphics, Statistics & Analysis, Basic IT Skills, Fundamentals of

Computer, Fundamentals of Electrical and Electronics Engineering, Project Management skills and Multimedia & Animation.

In the 2nd year of study, you would have studied Python Programming, Computer Hardware, Maintenance and Administration, Computer Networks, Database System Concepts and PL/SQL, Data Structures with Python, Operating System and Administration, Object oriented programming and Design with Java, Software Engineering principles and practices.

In this year of study, you shall be applying your previous years learning along with specialised field of study into projects and real-world applications.

Course Cohort Owner

A Course Cohort Owner is a faculty from the core discipline, who is fully responsible for one specialised field of study and the cohort of students who have chosen to study that specialised field of study.

Guidelines for Cohort Owner

1. Each Specialized field of study is restricted to a Cohort of 20 students which could include students from other relevant programs.
2. One faculty from the Core Discipline shall be the Cohort Owner, who for teaching and learning in allied disciplines can work with faculty from other disciplines or industry experts.
3. The course shall be delivered in boot camp mode spanning over 12 weeks of study, weekly developmental assessments and culminating in a mini capstone.
4. The industry session shall be addressed by industry subject experts in the discipline only.
5. The cohort owner shall be responsible to identify experts from the relevant field and organize industry session as per schedule.
6. Cohort owner shall plan and accompany the cohort for any industrial visits.
7. Cohort owner shall maintain and document industrial assignments, weekly assessments, practices and mini project.
8. The cohort owner shall coordinate with faculties across programs needed for their course to ensure seamless delivery as per time table
9. The cohort owner along with classroom sessions can augment or use supplementally teaching and learning opportunities including good quality online courses available on platforms like Karnataka LMS, Infosys Springboard, NPTEL, Unacademy, SWAYAM , etc.

Course outcome: A student should be able to

CO1	**Explain the concept of AI, its applications, constituents and challenges of ethics in AI.**
CO2	**Analyze and visualize any given dataset**
CO3	**Evaluate, optimize, build and test an AI model for a given requirement**
CO4	**Perform comparative analysis of methods or algorithms for a given requirement**
CO5	**Select the appropriate tools, production environment and deploy the model.**

Detailed course plan

Week	C O	P O	Days	1st session (9am to 1 pm)	L	T	P	2ND session (1.30pm to 4.30pm)	L	T	P
1	1	1	1	1. AI based movie (Screening)			4	- AI influence in companies viz, Amazon, Microsoft, Google, IBM - Latest developments in AI domain - Google's DeepMind AI Just Taught Itself To Walk - YouTube - Introducing Amazon Go and the world's most advanced shopping technology - YouTube - IBM Watson - Understanding the evolution of AI and HMI (human machine interface) - Discussion on how AI will Impact of daily life, work life, work force, jobs, products and services – T	2		1
	1	1	2	Fundamentals of AI - What is artificial intelligence? - How AI works - Purpose of AI - Types of Artificial Intelligence - Goals of AI	3		1	- Significance of data in AI - AI Software Development life cycle - Compare traditional software development with AI Software Development - Example – Game rules (Chess)	2		1

				- Applications of AI - Ethics in AI Examples of AI in real world - T				Explore and prepare a report on all popular AI cloud services (ML & DL) offered by vendors - T			
	5	4	3	Why Do We Need a Version Control System? Fundamentals of Git Git installation and setup basic local Git operations ▪ creating a repository, ▪ cloning a repository, ▪ making and recording changes ▪ staging and committing changes, ▪ viewing the history of all the changes ▪ undoing changes	1		3	Git Branching and merging Basic ▪ Creating and switching to new branches ▪ Switching between branches ▪ Merging local branches together			3
	5	4	4	GitHub - Basics of distributed git - Account creation and configuration - Create and push to repositories - versioning - Collaboration - Migration	1		3	Create repository – named mini project-1 Push the same to GitHub TOC - Git Essentials: Become a Git and GitHub Ninja | Infosys Springboard (onwingspan.com)			3
			5	**Developmental Assessment**				Assessment Review and corrective action			3
	1	**1,5**	6	Real industry experience of AI	2		3	Weekly Assignment(1PM-2PM)			

2	1	1	1	Peer Review		4		**Machine Learning** - Fundamentals - Machine learning types - Machine learning workflow - Machine learning applications - Challenges in ML - Building a model – steps involved - Pipelines ▪ Data engineering ▪ Machine learning ▪ Deployment - What is Data Science? - How Data Science works? - Data Science uses Group discussion - Examples of ML in everyday life / Use of Machine Learning in Daily Life Machine Leaning Terminologies - T TOC - Machine Learning Fundamentals | Infosys Springboard (onwingspan.com) Prediction – continuous value	2		1
	1,5	1,4	2	Introduction to Cloud Computing Essentials of Cloud Computing Cloud Deployment Models Cloud Service Models	2		2	Introduction to Containers Cloud Native application development Explore AI (ML and DL) services across public cloud platforms	1		2

				Serverless Services Major Cloud service Providers Virtualization Explore the cloud service providers and services offered by them - T				Note : teacher has to choose a public cloud platform to perform the fallowing activities - Getting to know cloud platform - Creating an account			
	1,5	**4**	3	Walking through the administrative console and Cloud SDK Explore Virtual machines (PaaS, Iaas and SaaS) and storage options Deploy a simple application on the cloud AI Platform overview	1		3	Essentials of cloud billing Cloud VPN SLA Deploy one simple web app on web server using cloud platform TOC - Essentials of Cloud Computing | Infosys Springboard (onwingspan.com)	1		2
	1	1,3, 4	4	Big Data - What is Big Data? - Vs of Big Data - Sources of data - Role of Big Data in AI&ML Python Packages for Machine Learning and Deep Learning - Scientifics computing libraries - Visualization Libraries - Algorithmic libraries Environment setup: install required packages Explore above listed packages	1		3	Python recap Database connectivity	1		2

			5	**Developmental Assessment**				Assessment Review and corrective action			3
	1,5	**2,3 ,4**	6	Build applications using AI cloud services	2		3	Weekly Assignment			
3	**1,5**	**2,3 ,4**	1	Peer review		4		Explore NumPy Module - Array Aggregation Functions - Vectorized Operations - Use Map, Filter, Reduce and Lambda Functions with NumPy - TOC - Pandas and NumPy Tips, Tricks, and Techniques | Infosys Springboard (onwingspan.com)			3
	1,5	**2,3 ,4**	2	Explore Pandas modules - Aggregation and Grouping - Time Series Operations - Pivot and melt function - Use Map, Filter, Reduce and Lambda Functions with Pandas dataframes - TOC - Unpacking NumPy and Pandas | Infosys Springboard (onwingspan.com)	1		3	Contd.			3
	2,5	**2,3 ,4**	3	**Data visualization with python** - Visualization fundamentals - Why visualization - Coordinate Systems and Axes - Directory of Visualizations	2		2	- Visualizing Amounts - Visualizing distributions - Visualizing proportions - Visualizing associations			3

				Amounts, Distributions, Proportions, x-y Relationships, Uncertainty Basics of python visualization with Matplotlib - Understand the anatomy of a figure - Plot creation - Plotting routines - Basic plot customizations - Saving plots				- Visualizing time series			
	2,5	2,3, 4	4	- Visualizing trends - Visualizing uncertainty - Visualizing categorical data - visualize proportions - visualize data on multi-plot grid - Composite views for informative summaries of data	1		3	Basics of python visualization with Seaborn The Course Overview - Viewer Page | Infosys Springboard (onwingspan.com)			3
			5	**CIE 1 – Written and Practice Test**				Assessment Review and corrective action			3
	1	4	6	How to create project plan and product backlog for AI project Create Git Repository for following Regression Project - ML / deep learning Classification Project – ML / deep learning Clustering project – ML / deep learning	2		3	Weekly Assignment			

				Natural Language Processing – ML / deep learning							
4	2	**2,3 ,4**	1	**Peer review** **Mini Project Activity (2)** - **Regression** - **Classification** **(Individual/ Team of 2)** - Define Problem statement (solution to be presented at the semester end) - Create project plan and product backlog - Create git repository for the project - Work progress should be monitored weekly		4		**Data engineering pipeline** **Data Collection** - Population and sample - Types of data ▪ Data type (type 1 (cross sectional, time series), type 2 (univariate, multivariate)) ▪ Variable types (categorical, ordinal, ratio, interval) - Data Collection Key terminologies in Statistics – T **<u>Mini Project Activity</u>** - Data collection for the stated problem	2		1
	2	1,3	2	**Probability** - **Basic concepts** - Conditional and Joint probability - Bayes' Theorem Probability Distributions - Discrete - Continuous - Central Limit Theorem	2		2	**Exploratory data analysis** - overview - EDA goals and benefits **Univariate data analysis** - Characterizing data with descriptive statistics - Univariate distribution plots - Univariate comparison plots - Univariate composition plots	1		2

				Infosys Springboard (onwingspan.com) TOC - Probability Distribution using Python | Infosys Springboard (onwingspan.com)				**Mini Project Activity** Data Exploration and analysis for the stated problem			
	2	**2,3 ,4**	3	**Univariate analysis tests** Hypothesis testing Error, Test statistic, type, interpreting test statistics. Understanding p-value	1		3	**Multivariate analysis** Finding relationship in data - Covariance - Correlation	1		2
	2	**2,3 ,4**	4	- Multivariate distribution plot Multivariate comparison plot Multivariate relationship plot Multivariate composition plot - TOC - Exploratory Data Analysis with Pandas and Python 3.x | Infosys Springboard (onwingspan.com) **Mini Project Activity – Status review** (Data Exploration and analysis for the stated problem)			4	**Linear algebra using python** - Scalars - Vectors - Matrices - Tensors Gradients - **E**igen values and eigen vectors - Norms and Eigen decomposition TOC - Basics of Linear Algebra using Python | Infosys Springboard (onwingspan.com) Interactive Scenario: Introduction to Vector Algebra Using Python (oreilly.com)	1		2
			5	**Developmental Assessment**				Assessment Review and corrective action			3
	2	**2,3 ,4**	6	Statistics and Linear algebra	2		3	Weekly assignment			
5	2,5	**2,3 ,4**	1	Peer review		4		**Data Preprocessing**	1		2

				Mini Project Activity – Status review				Importance of data preprocessing **Data cleaning** - Assess Data quality - Data anomalies - Detect missing values with pandas dataframe functions: .info() and .isna() - Diagnose type of missing values with visual and statistical methods (eg. chi-squared test of independence) Approaches to deal with missing values ▪ Keep the missing value as is ▪ Remove data objects with missing values ▪ Remove the attributes with missing values ▪ Estimate and impute missing values			
	2,5	**2,3 ,4**	2	Practice: Dealing with missing values with different approaches Outliers Detecting outliers ▪ univariate outlier detection ▪ bivariate outlier detection ▪ Time series outlier detection	1		3	Dealing with outliers - Do nothing - Replace with the upper cap or lower cap - Perform a log transformation - Remove data objects with outliers Practice: Dealing with outliers with different approaches			3

								TOC - Data Preprocessing | Infosys Springboard (onwingspan.com) TOC - Data Cleaning and Transformation | Infosys Springboard (onwingspan.com)			

	2,5	**2,3 ,4**	3	Data Integration
				- Overview
				- data integration challenges
				- Approaches
				  - Adding attributes
				  - Adding data objects
				Practice: data integration
					1		3	Data reduction
								- Distinction between data reduction and data redundancy
								- Objectives
								- Methods
								  o numerosity data reduction
								  o dimensionality data reduction
								Practice: Data reduction with numerosity data reduction method
									1		2

	2,5	**2,3 ,4**	4	Data transformation Need for data transformation. - **Normalization** - Standardization Data transformation with - binary coding - ranking transformation - discretization	1		3	Data transformation with - ranking transformation - discretization			3
			5	**CIE 2 – Written and Practice Test**				Assessment Review and corrective action			3

	2,5	**2,3 ,4**	6	**Feature engineering**	2		3	Weekly Assignment			
6	**2,3 ,5**	**2,3 ,4**	1	Peer review **Mini Project Activity – Status review**	4			**Data Splitting** Importance of data splitting - Training set - Validation set - Testing set Underfitting and overfitting Practice : split training and testing data sets in Python using train_test_split() of sci-kit learn. Explore the options of train_test_split()	1		2
	2,3 ,5	**2,3 ,4**	2	**Machine Learning pipeline:** **Model training** - Supervised Learning: Regression - What is Regression? - Types of regression - Regularization in ML - Real-Life Applications - T - Linear regression Overview Types - simple linear regression - Multiple linear regression	2		2	Understanding Simple linear regression - Regression equation - Assumptions - Gradient descent - Setting up the regression problem Practice: student score based on study hours Problem statement: • Create a model to analyses the relation between CIE and SEE result • Create a model to analyze the relation between crop yield and rain fall rate Build linear regression model using	1		2

				- Polynomial linear regression Applications of Linear Regression - T				- Stats model - Scikit learn			
	2,3 ,5	**2,3 ,4**	3	**Model Evaluation & testing** Evaluate regression model: Evaluation Metric - Coefficient of Determination or R-Squared (R2) - Root Mean Squared Error (RSME) - Optimize regression model - Gradient descent	2		2	Cross-validation Why do we need Cross-Validation? Techniques - Hold out method - Leave One Out Cross-Validation - K-Fold Cross-Validation	1		2
	2,3 ,5	**2,3 ,4**	4	Multiple Linear Regression - Overview - Assumptions - Normal Equation - Applications Identification and collection of regression dataset - T Perform data exploration, preprocessing and splitting on datasets like - Boston housing price from sci-kit learn datasets - Cricket match result - past data	2		2	Implementation in python - Build regression model - Evaluate the model - To minimize the cost function			3

				- Performance of a cricket player - past data - Crop yield - past data							
			5	**Developmental Assessment**				Assessment Review and corrective action			3
	2,3,5	**2,3,4**	6	**Optimization and performance matrices for regression**	2		3	Weekly Assignment			
7	**2,3,5**	**2,3,4**	1	Peer Review **Mini Project Activity – Status review**		4		Explore other regression algorithms - T Rebuild the model with other regression algorithms such as - Random Forest Regressor - Support Vector Regression - Lasso regression Evaluate and compare the performance of each.			3
	2,3,5	**2,3,4**	2	Supervised learning – classification What is classification? Types: - Binary classification - Multi-Label Classification - Multi-Class Classification - Imbalanced Classification Classification models Applications - T Practice: Iris dataset from sci-kit learn	2		2	Decision trees - What is decision tree? - Understanding Entropy, information gain - How to stop overfitting - Pruning DecisionTreeClassifier - How it works? - Understanding the parameters - Applications	3		

				Perform data exploration, preprocessing and splitting							
	2,3 ,5	**2,3 ,4**	3	Build decision tree-based model in python for like Breast Cancer Wisconsin (diagnostic) dataset from sci-kit learn Or any classification dataset from UCI , Kaggle			4	Evaluation Metrics for Classification - confusion matrix, - Accuracy - Precision and Recall - Specificity - F1-score - AUC-ROC ▪ How to compute ▪ How does it work ▪ When to use	1		2
	2,3 ,5	**2,3 ,4**	4	Evaluation Metrics for Classification- contd. Evaluation of decision tree model with different metrics			4	Hyper parameter tuning for DecisionTreeClassifier			3
			5	Development Assessment				Assessment Review and corrective action			3
	2,3 ,5	**2,3 ,4**	6	Hyper parameter tuning for classification	2		3	Weekly Assignment			
8	**2,3 ,5**	**2,3 ,4**	1	Peer review **Mini Project Activity – Status review**		4		Logistic regression - Overview - Types - How does logistic regression work? - Assumptions - Understanding sigmoid function	1		2

								- Applications Practice: build Logistic regression model in python			
	2,3,5	**2,3,4**	2	build Logistic regression model in python Evaluation and optimization of the model	2		2	Support Vector Machine - Introduction to SVM - How does it work? - Applications Practice: Build a SVM Model in python for Fish dataset from Kaggle	2		1
	2,3,5	**2,3,4**	3	Build a SVM Model in python How to optimize SVM?			4	**Ensemble Learning** Introduction Basic Ensemble Techniques - Max Voting - Averaging - Weighted Average Advanced Ensemble Techniques - Stacking - Blending - Bagging - Boosting Explore and list the Ensemble Algorithms - T Random Forest - Introduction - How does it work?			3

								- Hyper parameters - Applications			
	2,3 ,5	**2,3 ,4**	4	Build Random Forest-based model in python for Breast Cancer Wisconsin (diagnostic) dataset from sci-kit learn Or dataset from UCI , Kaggle			4	Evaluation and optimization			3
			5	**CIE 3 – Written and Practice Test**				Assessment Review and corrective action			3
	2,3 ,5	**2,3 ,4**	6	Comparison of classification algorithms with real world scenario	2		3	Weekly Assignment			
9	3	2,3	1	Peer review **Mini Project Activity – Status review**		4		Unsupervised learning – - What is unsupervised learning? - Common approaches - Challenges - Clustering Types Applications of unsupervised learning - T K-means – Working of K-means How to Choose the Right Number of Clusters?	2		1
	2,3 ,5	**2,3 ,4**	2	**Implementation in python** Evaluation Metrics - Inertia - Dunn Index Evaluate the model using mentioned metrics	1		3	**Contd.**			3

	2,3 ,5	**2,3 ,4**	3	Dimensionality Reduction - Importance of Dimension Reduction in machine learning Common methods to perform Dimension Reduction - T Dimensionality Reduction using PCA in python	2		2	Dimensionality Reduction using PCA in python			3
	5	3,4	4	Deployment Process - Local	2		2	Contd.			3
			5	**Development Assessment**				Assessment Review and corrective action			3
	4	2,3	6	Compare various clustering techniques	2		3	Weekly Assignment			
10	1	3,4	1	Peer review **<u>Mini Project Activity (2)</u>** - Regression - Rebuild with deep learning model - Classification - Rebuild with deep learning model - Analyze the performance of ML and DL **(Individual/ Team of 2)** - Define Problem statement (solution to be presented in the 13th week CIE – 6) - Create project plan and product backlog - Create git repository for the project Work progress should be monitored weekly		4		**Deep learning** - Limitations of Machine Learning - What is deep learning? - Deep learning models - Deep Learning Applications - Deep learning frameworks Group discussion – T Future -Impact deep learning will likely to have on a variety of industries in the next few years. Environment setup - Local - Cloud	2		1

								TOC - Deep Learning with TensorFlow | Infosys Springboard (onwingspan.com)			
	2,3	3,4	2	Introduction to Neural Networks ▪ Understanding - Biological Neurons - Artificial neuron /Perceptron - Working of perceptron ▪ Neural network - Architecture - Working of NN - Forward propagation - Back propagation ▪ Activation function - Sigmoid - Tanh - ReLU - LeakyReLU ▪ Cost function - How to measure loss? - How to reduce Loss? - Gradient Descent Get data, and explore	2		2	Introduction to TensorFlow - What is TensorFlow? - Why TensorFlow? - TensorFlow ecosystem - TensorFlow architecture - Program Elements in TensorFlow Keras - What is Keras? - Keras APIs – three programming models - Sequential Model - Functional API and - Model Subclassing - Keras layers - Custom Keras Layers TOC - Deep Learning with TensorFlow | Infosys Springboard (onwingspan.com) TOC - TensorFlow for Beginners | Infosys Springboard (onwingspan.com)	1		2

				Eg. Stroke Prediction Dataset | Kaggle or dataset from any other source Prepare data: Dealing with - missing values - Categorical values - Labeled encoding - One hot coding Prepare data : Feature scaling with StandardScalar() or other method Dropping unnecessary features Data splitting Dealing with imbalanced dataset						
	3	2,3, 4	3	- Why do we have to flatten the input data? - Understand Keras Dense Layer - Overview - Parameters - Operation - Building Shallow Neural Network with Keras Dense Layer - Building Deep Neural Network with Keras Dense Layers	1		3	Keras optimizers Keras Metrics Keras Losses Create a complete end to end neural network – Contd. TOC - Learning TensorFlow 2.0 | Infosys Springboard (onwingspan.com)	1		2

				- Create a complete end to end neural network model using Keras Sequential Model and Keras Layer API Eg. MNIST dataset (classify handwritten numerals) or fashion-MNIST dataset or dataset from other source							
	3	3,4	4	Keras - Callbacks - Commonly used callbacks Monitor neural network performance with TensorBoard - TensorBoard Basics - TensorBoard Setup Understand Model Behavior During Training Reduce overfitting with Dropout Layer	1		3	How to save trained model Local deployment with TensorFlow ModelServer			3
			5	**CIE 4 – Written and Practice Test**				Assessment Review and corrective action			3
	2,3	3,4	6	Building deep learning model with TensorFlow and Keras for use cases	2		3	Weekly Assignment			
11	1,5	2,3, 4	1	Peer Review **Mini Project Activity – Status review**		4		Natural Language Processing Understanding natural language processing	2		1

								NLP approaches – rule based, statistical NLP use cases How to use dictionary? Commonly used NLP tools & libraries Setup environment (spaCy or similar nlp package)			
	2,3	2,3, 4	2	Text processing tasks (Processing Words) Document Assembler Annotation Tokenization - Sentence tokenization - Word tokenization - Visualize frequency distribution of words - Visualize with word cloud Stop word - Dropping stop words - Dropping punctuations	1		3	Spell Correction Normalization - Stemming - Lemmatization	1		2
	2,3	3	3	Parts of speech tagging Named Entity Recognition	1		3	Vectorizer N-Gram	1		2
	2,3	2.3, 4	4	TF-IDF Build a pipeline for text processing	1		3	Contd.			3
			5	**Development Assessment**				Assessment Review and corrective action			3
	3	2,3	6	NLP – text summarization	2		3	Weekly Assignment			

12	1	2,3, 4	1	Peer review Mini Project Activity – Status review				Regular Expression - Introduction - Simple patterns – matching characters, repetition - Explore python 're' module			3
	1,2, 3	2,3, 4	2	NLP use case – Sentiment Analysis (SA) What is sentiment analysis? Why is SA important? Business applications for SA How does sentiment analysis work? Transformers Conduct Sentiment analysis to classify movie reviews with - spaCy TensorFlow and keras	2		2	Contd..			3
	1,2, 3,4, 5	2,3, 4,6	3	Ethics in AI - Importance of AI ethics - Ethical challenges of AI - AI code of ethics Group Discussion: Discussion on the Ethics of AI Ethics of AI: Safeguarding Humanity | Professional Education (mit.edu)			4	Deployment pipeline - Model Serving - Model Performance Monitoring - Model Performance logging Deployment strategies Deploying ML Models as Docker Containers			3
	2,3	3,4	4	Deploying ML Models as Serverless Functions			4	Contd.			3

			5	**CIE 5 – Written and Practice Test**				Assessment Review and corrective action			3
	1,3	5	6	Natural Language Generation / web scrapping	2		3	Weekly Assignment			
13	1 to 4	2,3, 4,6		**Internship** **a) Secondary research on various industries and their operations to identify at least 3 companies along with the areas of work interest and develop an internship plan that clearly highlights expectations from the industry during the internship.** **b) Design and develop a cover letter for an internship request to all 3 identified companies and the resume to be submitted to potential companies.** **Prepare for an internship interview to highlight your interests, areas of study, career aspirations and personnel competence – including the areas of learning you expect to learn during internship.**	2	4	19	**Project** **a) Identification of the problem statement (from at least 3 known problems) the students would like to work as part of the project – either as provided by faculty or as identified by the student. Document the impact the project will have from a technical, social and business perspective.** **b) Design and develop the project solution or methodology to be used to solve at least one of the problems identified.** **Prepare a project plan that will include a schedule, WBS, Budget and known risks along with strategies to mitigate them to ensure the project achieves the desired outcome.**		4	11

****Note:** Saturday session from 9 AM -2 PM

References

Sl. No	Description
1	Hands-On Artificial Intelligence for Beginners By Patrick D. Smith

2	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition, By Aurélien Géron
3	Machine Learning with Python for everyone, Mark E Fenner
4	Hands on Data processing in Python , Joy Jafari
5	Deep Learning with TensorFlow2 and Keras , Antonio Gulli, Amita Kapoor,Sujith Pal
6	Cloud Computing, Concepts, Technology and Architecture by Thomas Erl
7	Khan Academy
8	Fundamentals of Data Visualization, Claus O. Wilke
9	Pro Git ,Scott Chacon, Ben Straub
10	Mathematics for Machine Learning, A. Aldo Faisal, Cheng Soon Ong, and Marc Peter Deisenroth

CIE and SEE Assessment Methodologies

CIE Assessment	Assessment Mode	Duration In hours	Max Marks
Week 3	CIE 1– Written and practice test	4	30
Week 5	CIE 2– Written and practice test	4	30
Week 8	CIE 3– Written and practice test	4	30
Week 10	CIE 4– Written and practice test	4	30
Week 12	CIE 5– Written and practice test	4	30
Week 13	Assessment for Project or Internship	4	30
On line Course work (At least one related to the specialization)			30
Portfolio evaluation (Based on industrial assignments and weekly developmental assessment) *			30
TOTAL CIE MARKS (A)			**240**
SEE 1 - Theory exam (QP from BTE) Conducted for 100 marks 3 hour duration reduced to 60 marks		**3**	**60**

SEE 2 – Practical	**3**	**100**
TOTAL SEE MARKS (B)		**160**
TOTAL MARKS (A+B)		**400**

***** The industrial assignment shall be based on peer-to-peer assessment for a total of 10 marks (on a scale of 1 to 10) and in the event of a group assignment the marks awarded will be the same for the entire group, the developmental assessment will be for a total of 20 marks and based on MCQ/case study/demonstration and such other assignment methods

Scheme of Evaluation for SEE 2

Sl. No	Description	Marks
1	Case submission	20
2	Case presentation	20
3	Case innovation	20
4	Result	20
5	Viva voce	20
Total		**100**

Case Submission / Content Evaluation Rubrics

Evaluation Parameters	5	4	3	2	1	Student Score
Identification of the main issues / problem	**Identifies and understands all the main issues in the problem statemen**	Identifies and understands most of the main issues in the problem statement	Identifies and understands some of the issues in the problem statement	Identifies and understands a few of the issues in the problem statement	Identifies limited issues in the problem statement	5

Analysis of the issues	Insightful and thorough analysis of all the issues	**Thorough analysis of most of the issues**	Superficial analysis of some of the issues in the problem statement	Incomplete analysis of the issues	No analysis of the issue	4
Comments on effective solutions / strategies (The solution may be in the problem statement already or proposed by you)	Well documented, reasoned and pedagogically appropriate comments on solutions, or proposals for solutions, to all issues in the problem statement	Appropriate, well thought out comments about solutions, or proposals for solutions, to most of the issues in the problem statement	Superficial and / or inappropriate solutions to some of the issues in the problem statement	**Little and/or inappropriate solutions to all of the issues in the problem statement**	No action to all issues in the problem statement	2
Links to course learning and additional research	Excellent research into the issues with clearly documented links to course learnings and beyond.	Good research and documented links to the materials read during the course	**Limited research and documented links to any readings**	Incomplete research and links to any reading.	No research or links to any reading	3
Total						**14/20**

Case Presentation Evaluation Rubrics

Evaluation Parameters	5	4	3	2	1	Student Score
Delivery & Enthusiasm	Very clear and concise flow of ideas Demonstrates passionate interest in the topic and engagement with class / examiner	**Clear flow of ideas Demonstrates interest in the topic and engagement**	Most ideas flow but is lost at times Limited evidence of interest in and engagement with the topic	Hard to follow the flow of ideas Lack of enthusiasm and interest	No flow in the presentation Poor presentation skills	**4**

		with class / examiner				
Visuals	Visuals augmented and extended comprehension of the issues in unique ways	Use of visuals related to the topic	Limited use of visuals loosely related to the topic	**No use of visuals**	Poor visuals used and some visuals are not easy to understand its relevance.	**2**
Staging	**Uses stage effects such as props, sound effects, and speech modulation in a unique and dramatic manner that enhances the understanding of the issues in the problem statement.**	Uses stage effects such as props, sound effects, and speech modulation in an effective manner to extend the understanding of the issues in the problem statement.	Limited use of stage effects and/or used in a manner that did not enhance the understanding of the issues in the problem statement.	No use of stage effects	Poor stage effects usage	**5**
Involvement of the class / Examiners • **Questions** • **Discussions** • **Activities**	Excellent and salient discussion points that elucidated material to develop a deep understanding Appropriate and imaginative activities used to extend understanding in a creative manner	Questions and discussions addressed important information that developed understanding Appropriate activities used	**Questions and discussions addressed important superficial issues of the problem statement Limited use of activities to**	Little or no attempt to engage the class / examiner in demonstrating their learning	Did not engage the class / examiner and poor listening skills	**3**

		to clarify understanding	**clarify understanding**			
Total						**14/20**

Case Results Evaluation Rubrics

Evaluation Parameters	**5**	**4**	**3**	**2**	**1**	**Student Score**
Problem outcome	The topic was well researched and all information and data included are accurate and from reliable sources of information like high impact journals standards, etc. The proof was enough backed up with accurate data, analysis and reasoning beyond the class learning.	**The topic was researched and most information and data were from reliable sources of information. The proof was backed up with good data and reasoning as taught in the class. Outcome achieved as per the problem brief**	The topic was researched but information and data were only partly from reliable sources of information. The proof was not fully backed up with good data or reasoning as taught in the class. Partial outcome achieved as per the problem brief	The topic was researched and data were not from reliable sources. The proof was not backed up with data, analysis or reasoning as taught in the class. Some outcome obtained as per the problem brief	Desired results not obtained, but some relevant research was done. Outcome not obtained as per the problem brief	**4**

	Outcome achieved beyond the problem brief					
Application of class learning in problem solving	Made effective use of class principles, models and theories. Also used creativity to find effective results appropriate to industry beyond class learning.	Made good use of class principles, models and theories Some creative ideas were explored to find desired outcome but within the framework of class learning	**Made some use of class principles, models and theories No creative ideas or models explored**	Made limited use of class principles, models and theories	Poorly applied class principals, models and theories	**3**
Response to Class / Examiners Queries	Queries Excellent response to comments and discussion with appropriate content supported by theory/research	Good response to questions and discussions with some connection made to theory/research	Satisfactory response to questions and discussions with limited reference to theory/research	**Limited response to questions and discussions with no reference to theory/research**	Poor or no response to questions and did not participate in the discussions.	**2**
Conclusions	Provides detailed and appropriate conclusion for the problem statement	**Provides appropriate conclusion for the problem statement**	Provides adequate and mostly appropriate conclusions for the problem statement	Provides limited and somewhat appropriate conclusions for the problem statement	Has not provided appropriate conclusions for the problem statement.	**4**
Total						**13/20**

Case Innovation Evaluation Rubrics

Evaluation Parameters	5	4	3	2	1	Student Score
Finding new processes / models / approaches	**The newly discovered processes / models / approaches are of**	The newly discovered processes / models / approaches are of	The newly discovered processes / models / approaches have limited application but	The newly discovered processes / models / approaches has	No new processes / models /	**5**

	good quality and relevant	appropriate quality but limited relevance	relevant to the problem	restricted application	approaches were identified	
Proposing ideas and innovative solutions in terms of processes / models / approaches and how they can be applied to solve the problem on hand	Various ideas and innovative solutions have been proposed and their application have been clearly outlined	Various ideas and innovative solutions have been proposed as well as the outline of the process to apply them	**Some ideas or innovative solutions have been proposed but the process of applying them hasn't been specified**	Few ideas have been proposed	No ideas or innovative solutions have been proposed	**3**
Using creativity techniques to provide and reason good ideas which are original and unconventional	Wherever necessary creativity techniques are utilized to analyse and solve the problem	Creativity techniques are frequently utilized in more than 50% of the occasions	Creativity techniques are utilized at times in less than 50% of the occasions	**Creativity techniques are used a few times only**	Creativity technique are not utilized to analyse and solve the problem	**2**
Finding constraints and weak points in existing processes / models / approaches or methods	Constraints and weak points are understood	Constraints and weak are identified	**A critical analysis is undertaken**	Only a description of the working process and methods are provided	No constraints or weak points have been identified.	**3**
Total						**13/20**

Assessment framework for SEE (Theory) – 100 Marks / 3 hours (Reduced to 60 marks)

Programme: Computer Science & Engineering	**Semester: V**
Course: Artificial Intelligence & Machine Learning	**Max Marks: 100**
Course Code: 20CS51I	**Duration: 3 Hrs**

Instruction to the Candidate: Answer one full question from each section.

Qn.No	Question	CL	CO	Marks
	Section-1			
1.a)			1	
b)				
2.a)				
b)				
	Section-2			
3.a)			2	
b)				
4.a)				
b)				
	Section- 3			
5.a)			3	
b)				
6.a)				
b)				
	Section-4			
7.a)			4	
b)				
8.a)				
b)				
	Section-5			

9.a)			5	
b)				
10.a)				
b)				

Assessment framework for CIE

Note : Theory to be conducted for 1 hour and practice for 3 hours, total duration of exam – 4 hours

Programme	**Computer Science & Engineering**	**Semester**	**V**
Course	**Artificial Intelligence & Machine Learning**	**Max Marks**	**30**
Course Code	**20CS51I**	**Duration**	**4 hours**
Name of the course coordinator			

Note: Answer one full question from each section.

Qn.No	**Question**	**CL L3/L4**	**CO**	**PO**	**Marks**
Section-1 (Theory) – 10 marks					
1.a)					
b)					
2.a)					
b)					
c)					
Section-2 (Practical) - 20 marks					
3)					
4)					

Equipment/software list with Specification for a batch of 20 students

Sl. No.	Particulars	Specification	Quantity
1.	Computers	Intel i7, 4GB RAM, 500GB SSD	**20**
2.	Python (Anaconda Distribution), Git, Jira, Jenkins, TensorFlow or similar tools		
3.	Cloud – AWS/AZURE/GCB or any similar cloud environment		
4.	Broadband connection		