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]

Pathway	Course Category / Teaching Department	Course Code	Pathway Title	Hours per Semester			Total contact hrs /Semester	Credits	CIE Marks		SEE-1 Marks (Theory)		SEE-2 Mark (Practical)		Total Marks	Min Marks for Passing	Assigned Grade	Grade Point	SGPA and CGPA
				L	T	P			Max	Min	Max	Min	Max	Min					
Programme Specialization Pathway																			Both SGPA & CGPA
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			
		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				L	T	P	Total	Credit	CIE Marks		SEE Marks								
									Max	Min	Max		Min						
2	BS/SC Specialization pathway in Science and Research **(Student need to take all four papers in this pathway)**	2OSC51T	Paper 1-Applied Mathematics	52	26	0	78	6	50	20	50		20		100	40			
		2OSC52T	Paper 2 – Applied Science	52	0	52	104	6	50	20	50		20		100	40			
		2ORM53T	Paper 3 – Research Methodology	52	0	52	104	6	50	20	50		20		100	40			
		2OTW54P	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 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	CO	PO	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 - Applications 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) Explore and prepare a report on all popular AI cloud services (ML & DL) offered by vendors - T	2		1

				- Ethics in AI Examples of AI in real world - 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**	2		1

								- 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			
	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	1		3	Python recap Database connectivity	1		2

				Explore above listed packages							
			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	2		2	- Visualizing Amounts - Visualizing distributions			3

				- Coordinate Systems and Axes - Directory of Visualizations 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 proportions - Visualizing associations - 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	2		3	Weekly Assignment			

				Classification Project – ML / deep learning Clustering project – ML / deep learning 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	2		2	**Exploratory data analysis** - overview - EDA goals and benefits **Univariate data analysis** - Characterizing data with descriptive statistics - Univariate distribution plots	1		2

				- Continuous - Central Limit Theorem Infosys Springboard (onwingspan.com) TOC - Probability Distribution using Python | Infosys Springboard (onwingspan.com)				- Univariate comparison plots - Univariate composition plots **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 **Mini Project Activity – Status review**		4		**Data Preprocessing** 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	1		2
	2,5	**2,3 ,4**	2	Practice: Dealing with missing values with different approaches Outliers Detecting outliers ▪ univariate outlier detection ▪ bivariate 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			3

				▪ Time series outlier detection				Practice: Dealing with outliers with different approaches 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	1		3	Data transformation with - ranking transformation - discretization			3

				- discretization							
			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	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	1		2

				Types - simple linear regression - Multiple linear regression - Polynomial linear regression Applications of Linear Regression - T				• Create a model to analyze the relation between crop yield and rain fall rate Build linear regression model using - 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	2		2	Implementation in python - Build regression model - Evaluate the model - To minimize the cost function			3

				- Boston housing price from sci-kit learn datasets - Cricket match result - past data - 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	2		2	Decision trees - What is decision tree? - Understanding Entropy, information gain - How to stop overfitting - Pruning DecisionTreeClassifier - How it works?	3		

				Classification models Applications - T Practice: Iris dataset from sci-kit learn Perform data exploration, preprocessing and splitting				- Understanding the parameters - Applications			
	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	1		2

								- Types - How does logistic regression work? - Assumptions - Understanding sigmoid function - 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			3

								- Boosting Explore and list the Ensemble Algorithms - T Random Forest - Introduction - How does it work? - 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		4		**Deep learning** - Limitations of Machine Learning - What is deep learning? - Deep learning models - Deep Learning Applications - Deep learning frameworks Group discussion – T	2		1

				(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				Future -Impact deep learning will likely to have on a variety of industries in the next few years. Environment setup - Local - Cloud 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	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)	1		2

				- How to measure loss? - How to reduce Loss? - Gradient Descent Get data, and explore 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				TOC - TensorFlow for Beginners | Infosys Springboard (onwingspan.com)			
	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	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

				- Building Deep Neural Network with Keras Dense Layers - 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 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		1
	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			4	Deployment pipeline - Model Serving - Model Performance Monitoring - Model Performance logging Deployment strategies			3

				Ethics of AI: Safeguarding Humanity | Professional Education (mit.edu)				Deploying ML Models as Docker Containers			
	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 with class / examiner**	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**
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 to clarify understanding	**Questions and discussions addressed important superficial issues of the problem statement Limited use of activities to clarify understanding**	Little or no attempt to engage the class / examiner in demonstrating their learning	Did not engage the class / examiner and poor listening skills	**3**
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. Outcome achieved beyond the problem brief	**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**
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	Good response to questions and discussions with some	Satisfactory response to questions and discussions with	**Limited response to questions and discussions with**	Poor or no response to questions and did not	**2**

	appropriate content supported by theory/research	connection made to theory/research	limited reference to theory/research	**no reference to theory/research**	participate in the discussions.	
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 good quality and relevant**	The newly discovered processes / models / approaches are of appropriate quality but limited relevance	The newly discovered processes / models / approaches have limited application but relevant to the problem	The newly discovered processes / models / approaches has restricted application	No new processes / models / approaches were identified	**5**
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		

Full Stack Development

Diploma in Computer Science & Engineering

Program	**Computer Science & Engineering**	**Semester**	**5**
Course Code	**20CS52I**	**Type of Course**	**L:T:P (104:52:312)**
Course Name	**Full Stack Development**	**Credits**	**24**
CIE Marks	**240**	**SEE Marks**	**160**

Introduction: Welcome to the curriculum for the Full Stack Development 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 a complete suite of software development skills to build application like front-end, middleware, and back-end Java web developer technologies, test and deploy code, store data using MongoDB, and much more.
This course will teach you Fundamentals of business process automation, React, Spring, MongoDB, REST API, DevOps practices, 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 typical business process in an organization and identify opportunities for digital transformation.
CO2	Document system requirements and write an appropriate development plan.
CO3	Design, develop and test an automated business process.
CO4	Develop RESTful API's and test functions as per the defined requirements.
CO5	Select an appropriate production environment, UI and deploy the application.

Detailed course plan

Week	CO	PO	Days	1st session (9am to 1 pm)	L	T	P	2ND session (1.30pm to 4.30pm)	L	T	P
1	1	1	1	- What is an Enterprise? - Organizing the Enterprise - process - Understanding /Types of business activities - What is business process? - Why to automate business process?	4			- Digital transformation through Convergence of IT & OT - Digital Transformation Success Stories - How technology has impacted digital transformation - Case study: Digital transformation through IT/OT convergence	1		2
	1	1,5	2	**Industrial visit:** Visit small or medium scale nearby industry and know the business entity and activities. Understand the different work divisions with a business entity.		4		**Map the relationship between various divisions of business entity both vertical and horizontal relationships** **Understanding the business process and workflow within a business entity**			3
	1	2,3	3	**Report of industrial visit.** - Document the major business divisions and their activities. - Draw the workflow for each identified division.			4	- Identify the typical processes and workflows that can be automated. - Introduction to Full stack development, its components, tools used, etc. - Understanding Full stack framework both within firewall and on the cloud			3

				- Create a map of workflows to represent interaction among divisions and the entire business process as well.							
	1,2	2,3	4	Recap - Design Thinking - Apply design thinking to automate the observed activities in the industrial visit	1		3	Contd.			3
			5	Developmental Assessment				Assessment Review and corrective action			3
	1,2	2,3, 4	6	Full stack development – industrial perspective How to create project plan and product backlog for project and User story creation	2		3	Weekly Assignment(1PM-2PM)			
2	2,3	2,3, 4	1	peer review project activity: Make student teams (2 -3 students per team), each team is responsible for automating activities of an identified business entity. Integration of each team's work must lead to an enterprise application.		4		**Recap – software development (Agile methodology)** **Project Inception** - Define goal of product - Define epic /requirements - Creating user stories for the epic - Creating test plan - Creating testcase – test bed, test data	2		1
	2,3	2,3, 4	2	- Scope of product - Planning iterations / sprint planning	2		2	Design principles - Availability	2		1

				- Schedule of the project - Cost estimation - Burn down charts - Risk management Prepare the project environment by selecting tools Create and manage product backlog using appropriate tool like Jira				- Performance - Consistency - Scalability - Manageability - cost Architectural patterns - Monolithic - Layered - Service oriented architecture - Microservice architecture Step 01 - Need for Architecture - Viewer Page | Infosys Springboard (onwingspan.com)			
	2,3	2,3, 4	3	Design methods for security - Application security - Authentication and authorization methods and their usage and considerations o Token based o Cookie based o OpenID o Third party access o SAML o Multi factor authentication	2		2	Design principles for – UI / UX Create UI/UX design - for created user stories (wireframing) Technology, tools and frameworks for application development	2		1

				- Encryption Design methods for Datastores - Structured - Semi structured - Unstructured **Recap of** **Data base design**							
	2,3	2,3, 4	4	DevOps engineering practices - Configuration management - Continuous integration - Automated testing - Infrastructure as code - Continuous delivery - Continuous deployment - Continuous monitoring Explore the various tools used - T	2		2	**Configuration management** 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		2
			5	Developmental Assessment				Assessment Review and corrective action			3
			6	Comparison of various enterprise application development technology stacks (development, engineering, deployment, Monitoring)	2		3	Weekly Assignment			

				Security architecture and best practices in enterprise application programming.							
3	2,3	2,3, 4	1	Peer review Project status review Demonstration of artifacts of the project		4		Git Branching and merging Basic ▪ Creating and switching to new branches ▪ Switching between branches Merging local branches together	1		2
2	2,3	2,3, 4	2	GitHub - Basics of distributed git Account creation and configuration - Create and push to repositories - versioning - Collaboration - Migration Create repository – named mini project-1 Push the same to GitHub TOC - Git Essentials: Become a Git and GitHub Ninja | Infosys Springboard (onwingspan.com)	1		3	**Continuous integration with Jenkins** What is Jenkins? How does it work? Architecture of Jenkins Jenkins pipeline Install and configure Jenkins Perform user management Assign roles to users Create build pipeline with Jenkins TOC - Continuous Integration with Jenkins 2 | Infosys Springboard (onwingspan.com)	1		2
	5	1,4	3	**Continuous integration with Jenkins**			4	Contd.			3
	2,3	2,3, 4	4	Cloud basics - Service models - Deployment models	2		2	- Create cloud account (AWS, GCB or any other service provider) and explore the features			3

				- Cloud Infrastructure Overview - Cloud computing architecture and its components - Virtualization o Characteristics and benefits o Virtual Machines o Hypervisors o Types				- Create and setup a virtual machine. - Create a simple webapp using cloud services - Build a Basic Web Application on AWS (amazon.com)			
			5	**CIE 1 – Written and Practice Test**				Assessment Review and corrective action			3
	2,3	2,3, 4	6	Comparison of cloud services How to make full stack development efficient by using DevOps	2		3	Weekly Assignment			
4	2,3, 5	2,3, 4	1	Peer review Project status review Demonstration of artifacts of the project		4		Recap HTML, CSS and JavaScript Fundamentals (Code structure – statements, comments, variables, Constants, Data types, Interaction, Operators, Comparisons, Control flow, Functions) **Setting Up the Environment and Tools for front end development** - Installing Node.js - Installing VS Code - VS Code extensions	1		2

	2,3, 5	2,3, 4	2	JS objects Methods, Constructors, Object properties - Data properties - Accessor properties - Prototype	1		3	ES6 - Arrow functions - Template strings - Prototype methods - Spread operator	1		2
	2,3, 5	2,3, 4	3	ES6 - Map - Set	1		3	Introduction to TypeScript Why TypeScript? Setting up development environment for TypeScript - Install TypeScript compiler - Install Live server Create and run first program in TypeScript TypeScript "Hello, World!" (typescripttutorial.net)	1		2
	2,3, 5	2,3, 4	4	Basic Types Control flow statement Functions	2		2	Contd. JSON- T			3
			5	Development Assessment				Assessment Review and corrective action			3
	2,3, 5	2,3, 4	6	Modern UI technologies	2		3	Weekly Assignment			
5	2,3, 5	2,3, 4	1	Peer review Project status review Demonstration of artifacts of the project		4		Introduction to React - What is React?	1		2

								- Setting up React development environment - Anatomy of React app - Configuring react app - Creating and running a React.js app			
	2,3, 5	2,3, 4	2	Introduction to JSX What is JSX? DOM React DOM Implementing JSX	2		2	React Components What is a component? Types - Functional - Class Create your first React Component. Understanding Component life cycle	1		2
	2,3, 5	2,3, 4	3	React components - Presentational and Container Components - Functional components - Communication between components JSX for React components How to crate JSX elements? Props & State - Understanding Props How to test components	1		3	State and Props Component life cycle methods - Mounting phase - Updating phase - Unmounting phase - Error Handling	1		2

	2,3, 5	2,3, 4	4	Understanding React Virtual DOM MVC architecture React Router - React router – parameters - React router key components - Implement navigation using react router Building Single page application	2		2	Building Single page application	1		2
			5	CIE 2 – Written and Practice Test				Assessment Review and corrective action			3
	2,3, 5	2,3, 4	6	Testing single page application - manual and automation testing	2		3	Weekly Assignment			
6	2,3, 5	2,3, 4	1	Peer review Project status review Demonstration of artifacts of the project		4		Recap - Object oriented concepts and design principles - Data Structures - Database Concepts - java Setting up the environment and tools Install java (latest stable version) and add environment variable Install java editor (such as IntelliJ, Eclipse or any other) Install DBMS (MySQL, PostgreSQL or any other)	2		1

	2,3,5	2,3,4	2	- Java Collections (List, Set, Map) Basics of Apache Maven or Gradle – project management tool Understanding pom.xml XML – tutorial -	1		3	Introduction to Spring Framework What is Spring? - Why Spring Framework? - Spring Framework Architecture - Key components of Spring Framework	1		2
	2,3,5	2,3,4	3	understanding the spring initializer interface - Spring Annotations Create Spring application with Spring Initializer using dependencies like Spring Web, Spring Data JPI How to run the project	1		3	Inversion of Control and Dependency Injection What is inversion of control? What is dependency injection? Type of classes - Client class - Service class - Injector class Types of DI - Constructor - Property - Method Practice : constructor injection Property injection Method injection	1		2
	2,3,5	2,3,4	4	Spring IoC container – ApplicationContext AutoScanning – package scanning	2		2	Contd..			3

				DI in spring Boot - Constructor injection - Setter injection Autowiring Autowiring dependencies							
			5	Development assessment				Assessment Review and corrective action			3
	2,3, 5	2,3, 4	6	**Java and Frameworks**							
7	3,4	2,3, 4	1	Peer review Project status review Demonstration of artifacts of the project		4		Application Programming Interface (API) - What is an API? - How API works? - Why we need APIs? - API types (Open APIs, Partner APIs, Internal APIs, Composite APIs) - Types of API Protocols (SOAP, REST) Common API examples	2		1
	3,4	2,3, 4	2	API endpoints What is API endpoint? Why are API endpoints important? API endpoint examples How to Test API Endpoints HTTP Concepts - HTTP working	2		2	Basics of REST - Evolution of distributed API - Overview of REST - REST architectural style, components, views, - REST constraints - Properties of REST API			3

				- HTTP Method (GET, POST, PUT, DELETE) Understanding of JSON structure for API request and response data				- REST API Design Principles How to create RESTful service			
	3,4	2,3, 4	3	Spring REST – creating Spring REST controller Controller Layer – - Create REST controller for CRUD operations - Handling URI data Service Layer – build business logic Limitations of JDBC API Object relational Mapping – features and benefits - ORM Framework - ORM Architecture - ORM Mapping - ORM Annotations - ORM Configuration JPA – Java Persistent API	2		2	Spring Data JPA configuration Create ORM entity class Create database and configure using application.property file - **Note – Hibernate or any other ORM framework can be used About Hibernate Framework - Viewer Page | Infosys Springboard (onwingspan.com)			3
	3,4	2,3, 4	4	Model/ Repository layer – construct entity/ model object and communicate with DB using Spring Data JPI Install Postman Test created APIs with the help of Postman	1		3	Creating CRUD repositories			3

			5	**Developmental Assessment**				Assessment Review and corrective action			3
	3,4	2,3, 4	6	**Converting monolithic application to microservices architecture**	2		3	Weekly Assignment			
8	3,4	2,3, 4	1	Peer review Project status review Demonstration of artifacts of the project		4		Versioning Spring REST APIs Make RESTful service functional using Spring Data REST - CRUD operations using Spring Data JPA	1		2
	3,4	2,3, 4	2	Contd..			4	Contd..			3
	3,4	2,3, 4	3	Transaction management and compliance to ACID principles	1		3	Contd..			3
	3,4	2,3, 4	4	Securing REST APIs with Spring Security API security configuration	1		3	Creating unit tests with Spring Boot	1		2
			5	**CIE 3 – Written and Practice Test**				Assessment Review and corrective action			3
	3,4	2,3, 4	6	Spring Transactions				Weekly Assignment			
9	3,4	2,3, 4	1	Peer review Project status review Demonstration of artifacts of the project		4		Introduction NoSQL - 1 - Brief history - Features & Benefits - Types - Cap theorem - BASE Getting started with MongoDB	1		2

								- MongoDB overview - features - key components of Architecture - data modelling Working with MongoDB - MongoDB Shell – mongosh Mongo Compass GUI			
	3,4	2,3, 4	2	Setup - Download and Install MongoDB Community Server Or - MongoDB Atlas Setup - Create an Atlas account and get ready to use MongoDB Atlas - Configure MongoDB Atlas - Explore Compass (MongoDB's GUI tool) - Create and Manage MongoDB Data types and operators – T	1		3	CRUD Operations - Create and Drop database - Create and Drop Collections - CRUD Operations on document	1		2
	3,4	2,3, 4	3	- CRUD Operations on document			4	Limit and Sort Records Cursor	1		2
	3,4	2,3, 4	4	Indexing Aggregation	1		3	Replication Sharding	1		2
			5	Development Assessment				Assessment Review and corrective action			3

	3,4	2,3, 4	6	API Gateway				Weekly Assignment			
10	3,4	2,3, 4	1	Peer review Project status review Demonstration of artifacts of the project		4		Administration - Create and manage users and roles - Migration to MongoDB	1		2
	3,4	2,3, 4	2	Backup in MongoDB Types: Logical backups and physical backups. Back Up and Restore a MongoDB Database using - MongoDB Atlas - MongoDB Backup and Restore Tools	1		3	Monitoring Why Monitor MongoDB? Areas to monitor - Instance status and health - MongoDB cluster's operations and connections metrics - Instance hardware metrics - Replication metrics Monitor above areas with • MongoDB Atlas • self-managed MongoDB instances performance monitoring tools	1		2
	3,4	2,3, 4	3	ACID transactions in MongoDB Best practices for transactions in MongoDB	1		3	How to run MongoDB on cloud?			3
	3,4	2,3, 4	4	Perform CRUD Operations on MongoDB through REST API using Spring Boot Starter Data MongoDB	1		3	Contd.			3
			5	CIE 4 – Written and Practice Test				Assessment Review and corrective action			3

	3,4	2,3, 4	6	MongoDB implementation, administration and deployment				Weekly Assignment			
11	3,4, 5	2,3, 4	1	Peer review Project status review Demonstration of artifacts of the project		4		Application Testing - Manual - Automated Application testing tools Functional testing UI testing	1		2
	3,4, 5	2,3, 4	2	Integration testing - Jenkins System testing Integrate the work of each group and carry out integration testing	1		3	Automation testing with selenium (widely used) Components of selenium Features and limitations of selenium - T Components of WebDriver architecture Selenium WebDriver - Installation and setup	1		2
	3,4, 5	2,3, 4	3	WebDriver Script How WebDriver works? WebDriver Commands - Get, Navigation, WebElement, Action, and Result commands. Working with WebDriver commands Select Class and different select methods Working with WebDriver commands	1		3	Contd..			3
			4	Automation testing with selenium web driver			4	Acceptance testing Acceptance tests and test plan	1		2

								User acceptance testing Bug tracking – Jira			
			5	**Development Assessment**				Assessment Review and corrective action		3	
	3,4	2,3,4	6	Automation and cloud application testing							
12	3,4,5	2,3,4	1	Peer review Project status review Demonstration of artifacts of the project		4		Deployment process - Manual deployment - Automated deployment How to implement automated deployment? Top Deployment tools and their features Best Deployment practices Setup deployment pipeline Continuous deployment Static code analysis Automated review and peer review Practice – code analysis using tools	1		2
	3,4,5	2,3,4	2	Containers Why containers? What is a docker? How docker works? Components of docker - Docker container - Docker client - Docker daemon	1		3	Docker image Docker file Commands to create docker file. Build docker image with docker file create docker container from docker image Run the docker container	1		2

				- Docker image - Docker registry Install docker on desktop and start the docker tool. Explore and try other containers.							
	3,4, 5	2,3, 4	3	**Container orchestration** What is orchestration? Orchestration engine Orchestration tools Docker swarm – components and features	1		3	Disaster recovery and their types How does it work? Elements of disaster recovery plan Build a disaster recovery plan Load Balancing Load balancer and its functions	1		2
	3,4, 5	2,3, 4	4	Application monitoring - Need for application monitoring - Components of application performance management. - How to select application monitoring tools? Explore and compare APM tools	1		3	Contd. Redundancy and mirroring	1		2
			5	**CIE 5 – Written and Practice Test**				Assessment Review and corrective action			
			6	Cloud orchestration	2		3				
13			1	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				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			

				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.				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.			

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

References

Sl. No	Description
1	Hands-On Full Stack Development with Spring Boot 2.0 and React
2	React Cookbook , David Griffiths and Dawn Griffiths
3	Build a Basic Web Application on AWS (amazon.com)
4	A Docker Tutorial for Beginners (docker-curriculum.com)
5	Spring Boot 2.0 Projects By Mohamed Shazin Sadakath

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 duration 3hr. Max marks 100		**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 with class / examiner**	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**
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 to clarify understanding	**Questions and discussions addressed important superficial issues of the problem statement Limited use of activities to clarify understanding**	Little or no attempt to engage the class / examiner in demonstrating their learning	Did not engage the class / examiner and poor listening skills	**3**
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	**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**

	reasoning beyond the class learning. 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 good quality and relevant**	The newly discovered processes / models / approaches are of appropriate quality but limited relevance	The newly discovered processes / models / approaches have limited application but relevant to the problem	The newly discovered processes / models / approaches has restricted application	No new processes / models / approaches were identified	**5**
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: Full Stack Web Development	**Max Marks: 100**
Course Code: 20CS52I	**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	**Full Stack Development**	**Max Marks**	**30**
Course Code	**20CS52I**	**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
5.	**Computers**	Intel i7, 4GB RAM, 500GB SSD	**20**
6.	**Eclipse/InteliJ , Apache Maven, Spring 5.0, MongoDB, MySQL,React, Selenium WebDrive, Jira,Git,Jenkins**		
7.	**Cloud – AWS/AZURE/GCB or any similar cloud environment**		
8.	**Broadband connection**		

Cloud Computing

Diploma in Computer Science & Engineering

Program	**Computer Science & Engineering**	**Semester**	**5**
Course Code	**20CS53I**	**Type of Course**	**L:T:P (104:52:312)**
Course Name	**Cloud Computing**	**Credits**	**24**
CIE Marks	**240**	**SEE Marks**	**160**

Introduction:

With technological advances, the future is set to be highly competitive and agility is the need of the hour. With cloud computing, organizations can save money on storage, servers and management services, as these services can be moved to the cloud with minimum cost, making your operations more efficient. The cloud offers businesses more flexibility overall versus hosting on a local server. And, for need of extra bandwidth, a cloud-based service can meet that demand instantly, rather than undergoing a complex (and expensive) update to your IT infrastructure.

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.

This course will teach you Fundamentals of cloud computing Architecture, Compute instances, High Availability and Scalability in Cloud, Databases, Cloud Storage Service, DNS Services and Content Delivery, Serverless Computing, Container Services, Monitoring & Auditing and Cloud Security. Details of the curriculum is presented in the sections below.

Note: Faculty and students are free to choose any two open public cloud available such as Amazon Web Services (AWS), Microsoft Azure or Google Cloud Platform (GCP) etc. to implement the activities as suggested in the detailed curriculum.

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 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	**Work in cloud environment to demonstrate various aspects of Cloud computing and leverage them for project needs**
CO2	**Demonstrate the Public cloud services like compute, storage, networking, IAM, databases and configure them for given specification**
CO3	**Design, build and deploy a cloud native application using public cloud services and APIs**
CO4	**Adopt Cloud security policies, Monitor and troubleshoot basic issues in Cloud services**
CO5	**Administer cost, privileges and manage an existing deployed network**

Detailed course plan

Week	CO	PO	Days	1st session (9am to 1 pm)	L	T	P	2ND session (1.30pm to 4.30pm)	L	T	P
1	1	1	1	**Building blocks of cloud computing** - Introduction - Basic Architecture of Computer - Servers vs Desktop and laptops - Client-Server Computing - Hard Drives - HDDs and SDDs - Storage - block vs file vs object -	4			- IP addressing - Networking - Routers and Switches - Networking - Firewalls - Databases - Server virtualization - Docker Containers - Application Programming Interfaces (API)	2		1
	1	1	2	**Introduction to cloud computing** - Introduction - From Mainframes to Clouds Evolution – How to host an application in traditional IT Infra - What is Cloud Computing - Example Cloud Application deployment - Cloud Computing Service Models - Software as a Service (SaaS) - Platform as a Service (PaaS) - Infrastructure as a Service (IaaS) -	3		1	- Cloud Deployment Models - Public, Private, Hybrid, and Community. - List out the examples for each cloud models - Benefits of Cloud	2		1
	5	4	3	**Cloud Architecture** - Introduction	3		1	- Event-driven Architecture	2		1

				- Stateful vs Stateless Service - Scaling up vs Scaling out - Load Balancing - Fault Tolerance - Loose coupling - Monolithic and Microservices Architectures				- List out the Popular Cloud service providers along with their features (AWS, Azure, GCP) - Open Source cloud computing platforms			
	5	4	4	**Cloud Overview** **AWS** - Regions and AZ - Tour of AWS Console and Services in AWS - Creating an AWS Account - Shared Responsibility Model and AWS Acceptable Policy			4	**Azure** - Regions, Region Pairs, Sovereign Regions - Availability Zones and Data Centers - Resources, Resource Groups, Subscriptions, Management Groups - Overview of Azure Services - VM and App Services - Azure Storage and Data Services - Azure Networking Services and Microservices - Tour of the Azure Portal - Azure Free Account - Creating an Azure Free Account - Shared Responsibility Model			3
			5	**Developmental Assessment**				Assessment Review and corrective action			3
	1	**1,5**	6	Build blocks of Cloud Computing	2		3	Weekly Assignment(1PM-2PM)			

2	1	1	1	Peer Review		4		**Cloud IAM Services** - What is IAM ? - What is IAM used for ? - Principle of least privilege - AWS IAM - IAM Introduction: Users, Groups, Policies - IAM Users & Groups Hands on - IAM Policies - IAM Policies Hands On	2		1
	1,5	1,4	2	- IAM MFA Overview - IAM MFA Hands On - AWS Access Keys, CLI & SDK - AWS CLI Setup - AWS CLI Hands On - AWS Cloud Shell - IAM Roles for AWS Services - IAM Roles Hands On - IAM Security Tools - IAM Security Tools Hands On - IAM Best Practices			4	**Azure Active Directory** - Introduction to Azure Active Directory - Azure Active Directory Features - Azure Subscriptions - Creating an Azure subscription - Trust between Azure Subscription and Azure AD	1		2
	1,5	**4**	3	- Creating a user in Azure AD - Introduction to Role Based Access Control	2		2	- Lab - Azure AD - Creating a group - Azure AD Roles	1		2

				- Lab - Role-based assignments (Reader Role, Resource group level, Subscription level, Contributor Role, User Access Administrator Role)				- Lab - Azure AD- Assigning a Azure AD role - Azure AD Custom Domains - Self Service Password Reset - Lab on self-service password reset - MFA or 2FA			
	1	1,3, 4	4	- Lab - MFA on per user basis - Conditional Access Policies - Lab - Conditional Access Policies - Azure Powershell and Azure CLI - What is Powershell				- Installing Powershell - Quick look at a couple of commands - Installing Azure Powershell - Installing Azure CLI - Azure CLI Hands on	1		2
			5	**Developmental Assessment**				Assessment Review and corrective action			3
	1,5	**2,3 ,4**	6	IAM services	2		3	Weekly Assignment			
3	**1,5**	**2,3 ,4**	1	Peer review		4		**Cloud Computing Instances** - Virtualization in Cloud Computing - What is Virtualization ? - Virtualization as a Concept of Cloud Computing - Architecture of Virtualization - Types of Virtualization	2		1
	1,5	**2,3 ,4**	2	**AWS EC2 Instance**	1		3	- Private vs Public vs Elastic IP			3

				- EC2 Basics - Create a EC2 instance with EC2 user data - EC2 instance types basics - Security groups and classic ports - Lab - Security Groups - How to SSH to EC2 Instance - EC2 Instance Connect - EC2 Instance Roles Demo				- Lab - Private vs Public vs Elastic IP - EC2 Placement groups - Lab - EC2 Placement groups - Elastic Network Interface (ENI) Overview - Lab - ENI - EC2 Hibernate - Lab - EC2 Hibernate - EC2 Advance concepts (Nitro, vCPU, Capacity Reservations)			
	2,5	**2,3 ,4**	3	- EBS Overview - Lab - EBS - EBS Snapshots - Lab - EBS Snapshots - AMI Overview - Lab - AMI - EC2 Instance Store - EBS Volume Types - EBS Multi-Attach - EBS Encryption - EFS	1		4	**Azure Virtual Machines** - The Virtual Machine Service - Deploying a Virtual Machine - Lab - Building a Windows Virtual Machine - Connecting to the Virtual Machine - Lab - Installing IIS - State of the Virtual Machine - Lab - State of the Virtual Machine - Lab - Building a Linux Virtual Machine - Lab - Deploying a web server on the Linux virtual machine			3

				- Lab - EFS - EFS vs EBS							
	2,5	2,3, 4	4	- Lab - Deploying a Linux machine - SSH keys - The network interface - Network Security Groups - Lab - Network Security Groups - Azure Virtual Machines - Data Disks - Lab - Adding data disks - Server-side encryption - Azure Disk Storage - Encryption with customer managed keys - Lab - Azure Disk Encryption - Disks - Understanding IOPS and Throughput -	1		3	- Lab - Data Disks Snapshot - Azure Shared Disks - Lab - Un-managed disks - Lab - Custom Script Extensions - Lab - Linux Virtual Machines - Cloud init - Virtual Machine - Boot Diagnostics - Lab - Virtual Machine - Serial Console and Run command - Azure Dedicated Host			3
			5	**CIE 1 – Written and Practice Test**				Assessment Review and corrective action			3
	1	4	6	**Computing Instances**	2		3	Weekly Assignment			
4	2	**2,3 ,4**	1	Peer review		4		- **Cloud Networking** - Introduction	2		1

								- CIDR, Private vs Public IP - Subnet Overview - Networking - VPC - Default VPC Overview - VPC Overview - Lab - VPC - Lab – Subnet - Internet Gateways & Route Tables - Lab - Internet Gateways & Route Tables - Bastion Hosts - Lab - Bastion Hosts - NAT Instances - Lab - NAT Instances - NAT Gateways - Lab - NAT Gateways			
	2	1,3	2	- NACL & Security Groups - Lab - NACL & Security Groups - VPC Reachability Analyzer - Lab - VPC Reachability Analyzer - VPC Peering - Lab - VPC Peering - VPC Endpoints - Lab - VPC Endpoints	1		3	- Direct Connect & Direct Connect Gateway - AWS PrivateLink - VPC Endpoint Services - AWS ClassicLink - Transit Gateway - VPC Traffic Mirroring - IPv6 for VPC - Lab - IPv6 for VPC - Egress Only Internet Gateway	1		2

				- VPC Flow Logs - Lab - VPC Flow Logs - Site to Site VPN, Virtual Private Gateway & Customer Gateway - Lab - Site to Site VPN, Virtual Private Gateway & Customer Gateway				- Lab - Egress Only Internet Gateway - Networking Costs in AWS			
	2	**2,3,4**	3	- Virtual Networks in Azure - Introduction - The network interface - Lab - Working with Azure virtual networks - Lab - Deploying a machine to the virtual network	1		3	- Attaching a secondary network interface - Lab - Adding a secondary network interface - Network Security Groups - Lab - Network Security Groups (Working with rules, Priority setting, Subnets) - Virtual Network Peering - Lab - Virtual Network Peering - Setup and Implementation			3
	2	**2,3,4**	4	- Virtual private network - Point-to-Site VPN Connections - Lab - Point-to-Site VPN Connections - Site to Site VPN Connection - Lab - Site to Site VPN Connection - Azure VPN Gateway - High Availability - Azure ExpressRoute	2		2	- Connection Troubleshoot - Connection Monitor - IP Flow Verify - Next hop - NSG Diagnostic - Lab - Network Watcher - NSG Flow logs - User Defined Routes	1		2

				- Azure ExpressRoute peering - Network Watcher				- Lab - User Defined Routes (Setup, Route table and Enable forwarding) - Azure Firewall - Lab - Azure Firewall			
			5	**Developmental Assessment**				Assessment Review and corrective action			3
	2	**2,3 ,4**	6	**Cloud Networking**	2		3	Weekly assignment			
5	2,5	**2,3 ,4**	1	Peer review **Mini Project Activity – Status review**		4		**High Availability and Scalability in Cloud** - High Availability and Scalability - Elastic Load Balancer (ELB) and Auto Scaling Groups (ASG) - Classic Load Balancer (CLB) - Lab - CLB - Application Load Balancer (ALB) - Lab - ALB - Network Load Balancer (NLB) - Lab - NLB - Gateway Load Balancer (GWLB) - Elastic Load Balancer - Sticky Sessions - Elastic Load Balancer - Cross Zone Load Balancing - Elastic Load Balancer - SSL Certificates	1		2

								- Elastic Load Balancer - Connection Draining - Auto Scaling Groups (ASG) Overview - Lab - ASG - Auto Scaling Groups - Scaling Policies - Lab - Auto Scaling Groups - Scaling Policies			
	2,5	**2,3 ,4**	2	**Explore Availability and Scalability in Azure** - Availability Sets - Lab - Availability Sets - Use case scenario - Availability sets - Availability Zones - Lab - Availability Zones - Azure virtual machine scale sets - Lab - Azure Virtual Machine Scale Sets, Scaling conditions and Flexible Orchestration Mode -	1		3	**The Azure Load Balancer Service** - Azure Basic Load Balancer - Azure Load Balancer and SKU's - Lab - Basic Load Balancer - Setup and Implementation - Basic Load Balancer - NAT rules - Lab - Basic Load Balancer - Scale Set - Setting up the scale set,Setting up the scale set - Resources, Load Balancer Setup, Scaling - Lab - Azure Load Balancer - Standard SKU - Setup -			3
	2,5	**2,3 ,4**	3	- Lab - Azure Load Balancer - Standard SKU - Implementation			4	**Azure Application Gateway** - Open Systems Interconnection Model - Azure Application Gateway - Components	1		2

				- Lab - Azure Load Balancer - Multiple Backend Pools - Lab - NAT Rules - Same port number - Lab - Standard Load Balancer - Outbound Connectivity - Load Balancer - Session Persistence				- Lab - Azure Application Gateway - URL Routing - Setup and Implementation - Lab - Azure Application Gateway - Multiple Sites - Setup and Implementation			
	2,5	**2,3 ,4**	4	**Databases in Cloud** - Introduction - RDS, Aurora, ElasticCache - Amazon RDS Overview - RDS Read Replicas vs Multi AZ - Lab - Amazon RDS - RDS Encryption + Security - Amazon Aurora - Lab - Amazon Aurora - Aurora - Advanced Concepts - ElasticCache Overview - Lab - ElasticCache	1		3	**Azure Database Service** - Major Database Features - Database on VM - Azure SQL - Which Azure SQL to Choose? - Creating and Connecting to Azure SQL - Connecting the Catalog to the Database - Securing the Database Connection - Connecting the Inventory to the Database - Cosmos DB - SQL vs NoSQL Databases - Cosmos DB Consistency Levels - Creating and Using Cosmos DB - Connecting the Orders Function to Cosmos DB Azure MySQL and Azure PostgreSQL Overview			3
			5	**CIE 2 – Written and Practice Test**				Assessment Review and corrective action			3

	2,5	**2,3 ,4**	6	**High Availability and Scalability**	2		3	Weekly Assignment			
6	**2,3 ,5**	**2,3 ,4**	1	Peer review **Mini Project Activity – Status review**	4			**Cloud Storage Service** - AWS Storage Services - Amazon S3 - Section Introduction - S3 Buckets and Objects - Lab - S3 Buckets and Objects - S3 Versioning - Lab - S3 Versioning - S3 Encryption - Lab- S3 Encryption - S3 Security & Bucket Policies - Lab - S3 Security & Bucket Policies - S3 Websites - S3 CORS - Lab - S3 CORS	1		2
	2,3 ,5	**2,3 ,4**	2	- S3 Consistency Model - S3 MFA Delete - Lab - S3 MFA Delete - S3 Default Encryption - S3 Access Logs - Lab - S3 Access Logs	1		3	- Lab - S3 Pre-signed URLs - S3 Storage Classes + Glacier - Lab - S3 Storage Classes + Glacier - S3 Lifecycle Rules - Lab - S3 Lifecycle Rules - S3 Analytics - S3 Performance	1		2

				- S3 Replication (Cross Region and Same Region) - Lab - S3 Replication - S3 Pre-signed URLs				- S3 Event Notifications			
	2,3 ,5	**2,3 ,4**	3	- Athena Overview - Lab - Athena - AWS Snow Family Overview - Lab - AWS Snow Family - Amazon FSx - Lab - Amazon FSx - Storage Gateway Overview - Lab - Storage Gateway - AWS Transfer Family - Compare AWS Storage options	2		2	**Azure Storage Data Services** - Introduction - Benefits of Azure Storage - What are storage accounts - Different types of storage accounts - Lab - Creating an Azure storage account - Azure Blob service - Lab - Blob service - Uploading a blob, Accessing the blob	1		2
	2,3 ,5	**2,3 ,4**	4	- Azure Storage Accounts - Different authorization techniques - Lab - Using Azure Storage Explorer, Using Access keys - Lab - Shared Access Signatures - Blob Level, At the Storage Account Level - Lab - Azure Storage Accounts - Stored Access Policy			4	- Azure Storage Accounts - Data Redundancy - Configuring Storage Redundancy - Storage Accounts - Access Tiers - Lab - Storage Accounts - Hot and Cool Access Tier, Archive Access Tier - Azure Storage Accounts - Lifecycle policies			3

				- Lab - Azure Storage Accounts - Active Directory Authentication - Azure Storage Accounts - Different authorization techniques				- Lab - Azure Storage Accounts - Object Replication - Azure File shares - Lab - Working with File shares - Azure File Sync - Lab - Azure File Sync Service - Setup and Configuration			
			5	**Developmental Assessment**				Assessment Review and corrective action			3
	2,3 ,5	**2,3 ,4**	6	**Storage Service**	2		3	- Weekly Assignment			
7	**2,3 ,5**	**2,3 ,4**	1	Peer Review **Mini Project Activity – Status review**		4		**DNS Services and Content Delivery** - What is DNS ? - Route 53 - Overview - Route 53 - Registering a domain - Route 53 - Creating our first records - Route 53 - EC2 Setup - Route 53 - TTL - Route 53 CNAME vs Alias - Routing Policy - Simple, Weighted - Routing Policy - Latency - Route 53 - Health Checks - Lab - Route 53 - Health Checks			3

								- Routing Policy - Failover, GeoLocation, Geoproximity - Lab - Routing Policy - Traffic Flow & Geoproximity hands On - Routing Policy - Multi Value - 3rd Party Domains & Route 53			
	2,3 ,5	**2,3 ,4**	2	- What is CDN ? - Advantages of CDN - CloudFront & AWS Global Accelerator - CloudFront Overview - Lab - CloudFront with S3 - CloudFront Signed URL / Cookies - CloudFront Advanced Concepts - AWS Global Accelerator - Overview - Lab - AWS Global Accelerator	2		2	- Azure Private DNS - Lab- Azure Private DNS - Azure Public DNS - Azure CDN - Azure CDN Features - How to use Azure CDN ? - Lab - Create Azure CDN - Create a storage account - Enabling CDN for storage account	1		2
	2,3 ,5	**2,3 ,4**	3	**Serverless Computing in Cloud** - What is Serverless computing? - Benefits of serverless computing - Serverless application patterns - Serverless computing in AWS - Lambda Overview - Lab - Lambda	1		3	**Amazon DynamoDB** - Lab - Amazon DynamoDB - API Gateway Overview - Lab - API Gateway Overview - API Gateway Security - AWS Cognito Overview	1		2

				- Lambda Limits - Lambda@Edge				- Serverless Application Model (SAM) Overview			
	2,3 ,5	**2,3 ,4**	4	**Azure Serverless** - How Azure Does Serverless - Overview of Azure Functions - Lab - Creating and Testing a Azure Function - Logic Apps	1		3	Lab - Creating a Testing a Logic App - Azure Serverless Storage and Data - Using Azure Storage with Functions - Using Cosmos DB with Functions - Securing Azure Functions - Serverless Solutions Architecture			3
			5	Development Assessment				Assessment Review and corrective action			3
	2,3 ,5	**2,3 ,4**	6	**DNS Services and Content Delivery**	2		3	Weekly Assignment			
8	**2,3 ,5**	**2,3 ,4**	1	Peer review **Mini Project Activity – Status review**		4		**Container Services** - The need for containers - Introduction to Docker - Lab - Deploying Docker on a virtual machine - Lab - Running the nginx container on the Linux VM - Lab - Practice Docker commands - The need for an image registry	1		2
	2,3 ,5	**2,3 ,4**	2	**Amazon ECR** - Lab - Amazon ECR			4	**Azure Container Registry** - Lab - Azure Container Registry	2		1

				- Publishing to Amazon ECR				- Publishing to the Azure Container Registry - Publishing to the Azure Container Registry - Resources			
	2,3,5	**2,3,4**	3	**Amazon ECS** - Lab - Creating ECS Cluster - Lab - Creating ECS Service - Amazon ECS - Auto Scaling, Rolling Updated and Solutions Architectures			4	**Azure Container Instances** - Lab - Azure Container Instances and Azure Container Groups			3
	2,3,5	**2,3,4**	4	**Kubernetes** - What is Kubernetes ? - Kubernetes components - Learn Kubernetes Basics - Create a Cluster - Deploy an App - Explore your App - Expose your App Publicly - Scaling your App	1		3	**Azure Kubernetes Services (AKS) Overview** - Lab - Deploying an Azure Kubernetes cluster - Lab - Deploying our application **Amazon EKS Overview**			3
			5	**CIE 3 – Written and Practice Test**				Assessment Review and corrective action			3
	2,3,5	**2,3,4**	6	**Container Services**	2		3	Weekly Assignment			

9	3	2,3	1	Peer review **Mini Project Activity – Status review**		4		**Monitoring and Auditing** - AWS Monitoring - CloudWatch Metrics - CloudWatch Custom Metrics and Dashboards - CloudWatch Logs - Lab - CloudWatch Logs	2		1
	2,3 ,5	**2,3 ,4**	2	- CloudWatch Agent & CloudWatch Logs Agent - CloudWatch Alarms - Lab - CloudWatch Alarms - AWS CloudWatch Events - Amazon EventBridge	1		3	- CloudTrail Overview - Lab - CloudTrail - AWS Config - Overview - Lab - AWS Config - CloudTrail vs CloudWatch vs Config			3
	2,3 ,5	**2,3 ,4**	3	**Azure Monitoring** - Azure Monitor Service - Quick look at Azure Monitor	2		2	- Lab - Azure Monitor - Alerts - What is a Log Analytics Workspace? - Lab - Creating a Log Analytics workspace			3
	5	3,4	4	- Lab - Connecting virtual machine to the workspace - Log Analytics Queries - Lab - Log Analytics Queries			4	- Log Analytics - Alerts - What is Application Insights - Quick Look at Application Insights - Application Insights Tips and Tricks			3
			5	**Development Assessment**				Assessment Review and corrective action			3
	4	2,3	6	**Monitoring and Auditing**	2		3	Weekly Assignment			

10	1	3,4	1	Peer review **Mini Project Activity (2)**		4		**Cloud Security** - Introduction **Defense in depth in security** - AWS Security & Encryption - KMS Overview - Lab - KMS with CLI - KMS Key Rotation	1		2
	2,3	3,4	2	- SSM Parameter Store Overview - Lab - SSM Parameter Store (CLI) - Lab - SSM Parameter Store (AWS Lambda)			4	- AWS Secrets Manager - Overview - Lab - AWS Secrets Manager - CloudHSM - Shield - DDoS Protection	1		2
	3	2,3, 4	3	- Web Application Firewall (WAF) - Lab - WAF & Shield - Amazon GuardDuty	1		3	- Amazon Inspector - Macie - AWS Well Architected Framework with more focus on Security	1		2
	3	3,4	4	- VM Security Best Practices - Networking Security Best Practices - Database Security Best Practices - Zero Trust security	1		3	- Azure Key Vault - Azure Monitor - Azure Sentinel (SIEM and SOAR) - Azure Policy Azure Security Center			3
			5	**CIE 4 – Written and Practice Test**				Assessment Review and corrective action			3

	2,3	3,4	6	**Defense in depth in security**	2		3	Weekly Assignment			
11	1,5	2,3, 4	1	Peer Review **Mini Project Activity – Status review**		4		**Cloud Migration** - How to plan a cloud migration? - Cloud migration process - Cloud Migration strategies Prepare a report that, how will it helpful to small scale industry moving from its own data center to cloud?	2		1
	2,3	2,3, 4	2	- Cloud migration tools	1		3	Use any cloud migration tool and migrate a service.	1		2
	2,3	3	3	- AWS Tools	1		3	Cntd.			3
	2,3	2.3, 4	4	- Azure tools	1		3	Cntd.			3
			5	**Development Assessment**				Assessment Review and corrective action			3
	3	2,3	6	**Cloud Migration**	2		3	Weekly Assignment			
12	1	2,3, 4	1	Peer Review **Mini Project Activity – Status review**				**Big Data** - Big data examples BSE(5L orders/sec),jet engine, Bank transactions, Social Media - What is Big Data? - Types of Big data - V's of Big Data - Sources of data - Role of Big Data in AI&ML	2		1

	1,2,3	2,3,4	2	- **Apache Hadoop** - **HDFS** Install big data solution softwares like MangoDB, Hadoop Mapreduce or any other software	2		2	**Data Collection** - Frequency of data - Flow characteristics of data (Streaming, Transaction, Batch processing) - Data Cleaning or Data Cleansing 1. Consider a local big-data source, identify the frequency, flow of data. 2. Cleanse (eg: remove duplicates, formatting mistakes, organize) the data based on requirements given by owner of data (create your own rules)	1		2
	1,2,3,4,5	2,3,4,6	3	- Transformation - Data acquisition - Integration Transfer the data using an ETL tool and store it in a big-data solution DB (like MangoDB) Storage and Data Management - Storage Solutions based on - cost and efficiency - latency and durability characteristics	2		2	- Data Access - update patterns (e.g. bulk, transactional, batch/micro-batch) access patterns (e.g. sequential vs. random access, continuous usage vs.ad hoc) 1. Calculate efficiency of different big-data solutions during a. bulk b. transactional c. micro-batch updates 2. Calculate efficiency of different big-data solutions during a. sequential vs. random access b. continuous usage vs ad hoc			3

				1. Compare multiple big-data solutions based on a. Cost and Efficiency b. Latency and durability							
	2,3	3,4	4	**Managing Metadata** - creating and updating data catalogs and metadata			4	- searching and retrieving data catalogs and metadata Create or update a standard or custom metadata using AWS S3 or any other cloud service			3
			5	**CIE 5 – Written and Practice Test**				Assessment Review and corrective action			3
	1,3	5	6	Apache Hadoop	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.**		4	11

								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.			

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

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 with class / examiner**	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**
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 to clarify understanding	**Questions and discussions addressed important superficial issues of the problem statement Limited use of activities to clarify understanding**	Little or no attempt to engage the class / examiner in demonstrating their learning	Did not engage the class / examiner and poor listening skills	**3**
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. Outcome achieved beyond the problem brief	**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**
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	Good response to questions and discussions with some	Satisfactory response to questions and discussions with	**Limited response to questions and discussions with**	Poor or no response to questions and did not	**2**

	appropriate content supported by theory/research	connection made to theory/research	limited reference to theory/research	**no reference to theory/research**	participate in the discussions.	
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 good quality and relevant**	The newly discovered processes / models / approaches are of appropriate quality but limited relevance	The newly discovered processes / models / approaches have limited application but relevant to the problem	The newly discovered processes / models / approaches has restricted application	No new processes / models / approaches were identified	**5**
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:	**Cloud Computing**	**Max Marks: 100**
Course Code:	**20CS53I**	**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	**Cloud Computing**	**Max Marks**	**30**
Course Code	**20CS53I**	**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
9.	Computers	Intel i5, 4GB RAM, 500GB SSD	20
10.	Cloud – AWS/AZURE/GCP or any similar public cloud environment		20
11.	Broadband connection	Atleast 50MBPS	1

Cyber Security

Diploma in Computer Science & Engineering

Program	**Computer Science & Engineering**	**Semester**	**5**
Course Code	**20CS54I**	**Type of Course**	**L:T:P (104:52:312)**
Course Name	**Cyber Security**	**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 13 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 the era of connected computing devices, securing the personal data, application, system, network and organization becomes the challenging task in the field of Computer science and Engineering. The specialization prepare students to take up job or to become entrepreneur in the challenging area of Cyber security

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

10. Each Specialized field of study is restricted to a Cohort of 20 students which could include students from other relevant programs.
11. 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.
12. The course shall be delivered in boot camp mode spanning over 12 weeks of study, weekly developmental assessments and culminating in a mini capstone.
13. The industry session shall be addressed by industry subject experts in the discipline only.
14. The cohort owner shall be responsible to identify experts from the relevant field and organize industry session as per schedule.
15. Cohort owner shall plan and accompany the cohort for any industrial visits.
16. Cohort owner shall maintain and document industrial assignments, weekly assessments, practices and mini project.
17. The cohort owner shall coordinate with faculties across programs needed for their course to ensure seamless delivery as per time table
18. 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	Design, optimize, operate and maintain a secure network/system/application/cloud and data resources for given requirements
CO2	Apply cryptography to secure a cyber system.
CO3	Respond to incidents to mitigate immediate and potential threats .
CO4	Test, implement, deploy, maintain and review the infrastructure to effectively manage the network and resources.
CO5	Monitor network to actively remediate unauthorized activities.

Detailed course plan

Week	CO	PO	Days	1st session (9am to 1 pm)	L	T	P	2ND session (1.30pm to 4.30pm)	L	T	P
1	1	1	1	- Protecting your personal data - Online identity - Where is your data ? - Smart devices - What do attackers want ? - Identity theft - Protecting your organization data - Traditional data - Cloud; IoT; Big data - Types of data - Sensitive and non sensitive data - Personal data, PII data - Data classification - Ex: Govt. of India classification of data - Unclassified - Restricted - Confidential - Secret - Top secret -	4	-	-	Introduction and Basic concepts of cyber security What is Cyber security, Security principles CIA, AAA Vulnerability, Threat, Risk, attack and Impact People, Process and Technology McCumbers Cube Cyber Security - Brief history and types - Infrastructure, network, cloud, IOT, application. - Purpose and Importance - Challenges - Applications How does cyber security work?	3		

	1	1,5	2	Recap – Topology OSI Model TCP/IP Model Internet protocols Network resources Router and Firewall, Hub, switch – security issues Basic Network terminologies	3		1	Hackers Who are they? What is not hacking Types of hackers Hacking methodologies Purpose Activity: Stuxnet - a case study	1		2
	1	2,3	3	Analysing a Cyber Attack Types of Malwares Spyware Malware Backdoor Ransomware Scareware Rootkit Virus Trojan horse Worms Symptoms of attack Methods of Infiltration Social Engineering Pretexting Tailgating Something for something (quid pro quo) Denial-of-Service and DDoS Botnet On the Path attack	3	1		- Defence in depth - What is defence in depth - Layers - Needs for Defence in depth - Examples - Host encryption - Anti-virus - Firewall - E-Mail gateway - Password management - Honeypot - Multi Factor Auth			3

				SEO Poisoning Wi-Fi Password Cracking Password Attacks Password spraying Dictionary attack Brute force Password Cracking Times Rainbow Traffic interception Advanced Persistent Threats Security Vulnerability and Exploits Hardware Vulnerabilities Meltdown and Spectre Software Vulnerabilities Categorizing Software Vulnerabilities Software updates						
	1,2	2,3	4	Data Maintenance Using free tools Back Up Your Data How Do You Delete Your Data Permanently? Tools Who owns your data? Terms of service Understand the term; what are you agreeing to? The data use policy Privacy settings Before you sign up protect your data Activity: Check terms of service of the popular application you use on your phone and check their data sharing policy, access to device etc.	2	1	1	Protecting Your Computing Devices turn the firewall on install antivirus and antispyware manage your operating system and browser set up password protection.			3

				Safeguarding Your Online Privacy Two Factor Authentication Open Authorization Social Sharing Email and Web Browser Privacy Activity: Discover your own risky online behaviour Scenario 1: posting private info on social media Scenario 2: What password you choose when creating new account for social service Scenario 3: Using public Wi-Fi - Scenario 4: Using trial version of the software Activity: Check if your password is compromised Note :Use Have I been pwned -							
			5	Developmental Assessment				Assessment Review and corrective action			3
	1,2	2,3, 4	6	**class: Cyber security at workplace**	2		3	Weekly Assignment(1PM-2PM)			
Reference materials : skillsforall.com – Introduction to Cyber security											
2	2,3	2,3, 4	1	Peer review Project / activity Propose problem statement		4		Why Do We Need a Version Control System? Fundamentals of Git Git installation and setup basic local Git operations ▪ creating a repository,	1		2

								▪ cloning a repository, ▪ making and recording changes ▪ staging and committing changes, ▪ viewing the history of all the changes undoing changes			
	2,3	2,3, 4	2	History of cryptography (overview: Caesar cipher, enigma cipher) Introduction (high level overview only) Enc (sym - stream + block ciphers, asym) Hashing Digital signature, MAC - PRNG	2		2	Algebra: groups, rings, fields - definitions + examples AES (SPN structure, rounds, modes of operation - high level overview with diagram) MAC + SHA2/3 (high level + security requirements))	1		2
	2,3	2,3, 4	3	RSA (with numerical examples) Digital signature (RSA)	2		2	Number theory - primes, modular arithmetic, gcd, Euler totient function - definitions + examples	1		2
	2,3	2,3, 4	4	Practice sessions/ student activities: - Numerical/programming exercises: subset of math / Caesar cipher / one time pad / RSA / GCD / primality Cryptanalysis (brute force over keys, birthday attacks on hash functions, hardness of	1		3	Practice sessions/ student activities: Inspect digital certificates using a web browser and visiting popular websites - Identify the crypto algorithms in TLS - Design a toy crypto algorithm like key generation + encryption + decryption / digital signature / hash function			3

				factoring integers, discrete log problem, side-channel attacks – high level overview) Applied crypto (PKI, Full disk encryption, blockchain: overview							
			5	**Developmental Assessment**				Assessment Review and corrective action			3
			6	**Industrial class : Application of cryptography**	2		3	Weekly Assignment			
References : • https://www.youtube.com/user/Computerphile - YouTube channel by Dr. Mike Pound • https://nptel.ac.in/courses/106105031/ : Cryptography and Network Security by Prof. Debdeep Mukhopadhyay, IIT Kharagpur • https://www.coursera.org/learn/crypto and https://www.coursera.org/learn/crypto2 : by Prof. Dan Boneh, Stanford University • http://williamstallings.com/Cryptography/ - student resources by Prof. William Stallings											
3	2,3	2,3, 4	1	Peer review Project / activity Propose problem statement and network design requirements		4		How Internet/Application works (Security aspects – end-to-end packet path) Network architecture concepts Understanding vulnerabilities in different OSI layers and protocols (TCP, UDP, IP, ICMP)			3

	2,3	2,3, 4	2	Network Security : Concepts- Firewall, IDS, IPS, VPN	2		2	Protocols : IPSec, SSL, TLS (versions and vulnerabilities)	1		2
	5	1,4	3	Web Security : Concepts-HTTP, HTML, Frames, browser design	2		2	Attacks and vulnerabilities: Injection attacks : SQL, HTTP header, OS command	1		2
	2,3	2,3, 4	4	○ Wireless Security : Introduction to security issues in cellular networks, WIFI, LAN systems, RFID systems	2		2	- DOS attacks, countermeasures (in relation to wireless networks)	1		2
			5	**CIE 1 : Written and practice test**				Assessment Review and corrective action			3
	2,3	2,3, 4	6	**Industrial class :** High availability and load balancing	2		3	Weekly Assignment			
References : 1. https://www.cisco.com/c/en_in/products/security/what-is-network-security.html 2. https://purplesec.us/firewall-penetration-testing/ 3. How hackers do it: Tricks, Tools, and Techniques 4. https://cse29-iiith.vlabs.ac.in/ 5. https://nptel.ac.in/courses/106105031/ : Cryptography and Network Security by Prof. Debdeep Mukhopadhyay, IIT Kharagpur. 6. https://wiki.apnictraining.net/netsec-20220627-bdnog14/agenda											
4	2,3, 5	2,3, 4	1	Peer review Project status review Demonstration of artifacts of the project		4		Windows Security Windows Security Infrastructure Windows Family of Products Windows Workgroups and Accounts Windows Active Directory and Group Policy	2		1

	2,3, 5	2,3, 4	2	Windows as a Service End of Support Servicing Channels Windows Update Windows Server Update Services Windows Autopilot Windows Virtual Desktop Third-Party Patch Management Practice : Process observation and analysis with Process Hacker	2		2	Windows Access Controls NTFS Permissions Shared Folder Permissions Registry Key Permissions Active Directory Permissions Privileges BitLocker Drive Encryption Secure Boot - Practice : NTFS file system practical using NTFS Permissions Reporter	1		2
	2,3, 5	2,3, 4	3	Enforcing Security Policy Applying Security Templates Employing the Security Configuration and Analysis Snap-in Understanding Local Group Policy Objects Understanding Domain Group Policy Objects Administrative Users Privileged Account Management Reduction of Administrative Privileges AppLocker User Account Control Windows Firewall IPsec Authentication and Encryption	2		2	Linux Security Linux Fundamentals Operating System Comparison Linux Vulnerabilities Linux Operating System Shell Kernel Filesystem Linux Unified Key Setup Linux Security Permissions Linux User Accounts Pluggable Authentication Modules Built-in Command-Line Capability	1		2

				Remote Desktop Services Recommended GPO Settings. Practice : Auditing and enforcement of system baseline configurations with security templates PowerShell scripting and automation techniques				Service Hardening Package Management			
	2,3, 5	2,3, 4	4	Linux Security Enhancements and Infrastructure Operating System Enhancements ○ SE Linux ○ App Armor Linux Hardening ○ Address Space Layout Randomization ○ Kernel Module Security ○ SSH Hardening ○ Open SCAP ○ CIS Hardening Guides and Utilities	2		2	Log Files ○ Key Log Files ○ Syslog ○ Syslog Security ○ Log Rotation ○ Centralized ○ Logging ○ Audit id ○ Firewalls: Network and Endpoint ○ Rootkit Detection	1		2
			5	Development Assessment (Hardening the image win and linux CIS controls)				Assessment Review and corrective action			3
	2,3, 5	2,3, 4	6	Industrial Class : System Security	2		3	Weekly Assignment			
5	2,3, 5	2,3, 4	1	Peer review Project status review		4		Introduction to Application Security Secure SDLC	2		1

				Introduction to Software Application Development – How was it created, Why is it important? How does it work. Types of Application Software – Thick Client, Web Applications, Web Services, RESTFul Services, Middle Ware, Mobile Applications etc (Give an example of each). Explain Software Development Lifecycle – Requirements, Design, Develop, Deploy, Operate and Purge. Life Cycle Models – Waterfall, Agile, Iterative etc. SDLC Best Practices				Provide a use case – Microsoft Secure SDLC Practice and Security controls covered in each stage at a higher level. Requirements (Determine Application Risk Profile based on Security Requirements, Determine Control Requirements, Establish Quality Gates) b. Design (Architecture Design Review and Threat Modeling) c. Implementation (Static Analysis, Software Composition Analysis, Secret Detection, Deprecate unsafe functions, use of plugins in IDE, Safe Commit and Change Management in Repositories) d. Verification (Dynamic Analysis, Interactive Application Security Testing, Fuzz Testing, Abuse use case Testing, Architecture Verification). e. Release (Run Time Application Self Protection, Web Application Firewall, SOP for Operations, Secure Provisioning, Deployment and De commissioning) - f. Response (Incident Response).			

	2,3, 5	2,3, 4	2	Application Security – Requirements 1. Functional and Non Functional Requirements for an application 2. Security Requirements for an application 3. Determining Application Risk Profile Based on the security requirements. 4. Determining Control Requirements Based on Application Risk Profile and Eligibility Criteria for an application to undergo a certain security control. Establish Security Toll Gates	1		3	Application Security Design: Secure Architecture Review – For a given use case, with examples; conduct security architecture review using the OWASP standard.	1		2
	2,3, 5	2,3, 4	3	Application Security Design – Threat Modelling. 1. Why Threat Modelling 2. What is Threat Modelling 3. Threat Modelling Methodologies – STRIDE, PASTA, OCTAVE, TRIKE, VAST. 4. Threat Model Ranking – DREAD, CVSS, CWSS etc. Threat Model Execution Phases: - Planning, Scoping, Deep Dive Discussions, Drawing a	1		3	- Using the Microsoft Threat Modeling methodology, execute a threat model for a given application architecture using Microsoft threat modeling tool.			3

				Threat Model, Identifying Threats, Threat Objects, Security Controls, Threat Actors, Threat Traceability Matrix, Reporting and Debrief.							
	2,3, 5	2,3, 4	4	Application Security – Implementation - Explain use of Security Tools within IDE. - Static Code Analysis Tools – Explain with examples. - Explain Software Composition Analysis, Identifying Software Dependencies and CVE in underlying libraries. Demonstrate a tool like OWASP Dependency Check.	1		3	Explain Secret Detection using tools like Githound. - Change Management during pre-commit and post-commit in repositories. - Safe SCM practices (Take Github as an example). - Highlight deprecated unsafe functions in common programming languages.			3
			5	CIE 2 – Written and Practice Test				Assessment Review and corrective action			3
	2,3, 5	2,3, 4	6	**Industrial class : Source Code Scan using a commercial tool like Microfocus Fortify or Checkmarz.**	2		3	Weekly Assignment			
6	2,3, 5	2,3, 4	1	Peer review Project status review		4		Application Security – Verification. Explain Dynamic Analysis using an example – owasp zap. Interactive Application Security Testing – Demonstrate using Contrast Security Tool.			3

	2,3, 5	2,3, 4	2	For a given site (local), conduct a dynamic analysis scan using OWASP ZAP, Check for False positives and create a report			4	Introduce Manual Security Testing using OWASP Testing Guide. Add Misuse case testing to the framework in addition	1		2
	2,3, 5	2,3, 4	3	Conduct a manual security testing for a local web application or an API using proxy tools like burp suite/paros etc and provide a report. Compare the results of both manual and automated scans. Application Security – Release 1. Explain Run Time Application Self Protection – Contrast Security or Microfocus Fortify Software can be used as an example. 2. Define Web Application Firewall. Demonstrate using a tool. Elaborate on Standard Operating Procedure for Operations, Secure Provisioning, deployment and decommissioning	1		3	- 1. Cover OWASP ASVS and its aid as a tool in architecture verification. Introduce OWASP SAMM – to attain software assurance maturity.	1		2
	2,3, 5	2,3, 4	4	Measurement of Application Security – Define Metrics, Type of Metrics (Operations, Efficiency, Quality etc). Example Application Security Metrics from OWASP.	1		3	For the previous run scans, define metrics and evaluate the values at operational level.			3

			5	Development assessment				Assessment Review and corrective action			3
	2,3, 5	2,3, 4	6	**Industrial class : Dynamic Analysis using Qualys**				Weekly Assignment Weekly Assignment (Suggestive Student Activities) 1. Install Web Goat and do an automated scan using one of the dynamic analysis tools. 2. Follow up with a manual security testing with OWASP Testing guide as an aid and compare the results of automated and dynamic scan.			

References:
1. https://www.synopsys.com/glossary/what-is-sdlc.html
2. https://www.synopsys.com/blogs/software-security/secure-sdlc/
3. https://www.microsoft.com/en-us/securityengineering/sdl
4. https://www.microsoft.com/en-us/securityengineering/sdl/threatmodeling
5. https://www.microsoft.com/en-in/download/details.aspx?id=49168
6. https://medium.com/@melsatar/software-development-life-cycle-models-and-methodologies-297cfe616a3a
7. https://owasp.org/www-project-application-security-verification-standard/
8. https://resources.infosecinstitute.com/topic/application-architecture-review/
9. https://owasp.org/www-community/controls/Static_Code_Analysis
10. https://owasp.org/www-project-web-security-testing-guide/
11. https://owasp.org/www-project-zap/
12. https://owasp.org/www-project-dependency-check/
13. https://www.synopsys.com/glossary/what-is-software-composition-analysis.html
14. https://owasp.org/www-project-samm/
15. https://github.com/tillson/git-hound
16. https://owasp.org/www-project-security-qualitative-metrics/
17. https://www.qualys.com/apps/web-app-scanning/
18. https://www.veracode.com/security/interactive-application-security-testing-iast
19. https://en.wikipedia.org/wiki/Runtime_application_self-protection
20. https://en.wikipedia.org/wiki/ModSecurity

21. https://github.com/WebGoat/WebGoat 22. https://spectralops.io/resources/how-to-choose-a-secret-scanning-solution-to-protect-credentials-in-your-code/ 23. https://www.geeksforgeeks.org/functional-vs-non-functional-requirements/ 24. https://owaspsamm.org/model/design/threat-assessment/stream-a/ 25. https://docs.42crunch.com/latest/content/concepts/security_quality_gates.htm											
7	3,4	2,3, 4	1	Peer review Project status review		4		Basics of cloud computing Why is cloud computing necessary? Introduction to key cloud services (Compute, storage, networking) Cloud delivery models IaaS v/s PaaS v/s SaaS Introduction to cloud vendors(Azure,AWS, GCP) Key Cloud Security Principles Shared responsibility model Principle of least privilege Defense in depth Threat actors, diagrams & trust boundaries Practice : Create a cloud account Create 2 accounts Setup 2FA on both account			3
	3,4	2,3, 4	2	Cloud asset management	1		3	Identity & Access management in the cloud Introduction to IAM Introduction to Federal Identity Management IAM Best Practices			3

								IAM Audit Intro to AWS/Azure clint and Web Portal			
	3,4	2,3,4	3	Vulnerability management Discovering cloud misconfiguration Remediating vulnerabilities Tracking open vulnerabilities using cloud native tools	1		3	Network security Security groups VPC WAF	1		2
	3,4	2,3,4	4	Incident response - Log analysis - Events & alerts - Key metrics (MTTD & MTTR)	1		3	Data protection in the cloud • Data protection at rest and at transit • Cloud data storage - AWS EBS, S3 / Azure SAS • Secrets Management			3
			5	**CIE 3 – Written and Practice Test** **Secure a vulnerable cloud env**				Assessment Review and corrective action			3
	3,4	2,3,4	6	**Industrial class :** **1. Preventing DDoS in a cloud native env** **Hybrid cloud env**	2		3	Weekly Assignment			
8	3,4	2,3,4	1	Peer review Project status review		4		Intro to VAPT Developing a Hacker Mindset • Ethics of Penetration Testing • Goal of Penetration Testing • Thinking like a Hacker	1		2
	3,4	2,3,4	2	ATT&CK Framework Overview Introduction to the framework			4	Contd..			3

				Deep dive into the key topics ○ Reconnaissance ○ Initial Access ○ Privilege Escalation ○ Lateral Movement ○ Exfiltration							
	3,4	2,3, 4	3	Web Application Penetration Testing ● Basics of Web ○ HTTP Methods ○ HTTP Requests & Response Session management & Cookies			4	Contd..			3
	3,4	2,3, 4	4	Web Application Penetration Testing Finding common web vulnerabilities (OWASP top 10) Burp Suite Essentials Practical: Setup Burp Suite on local machine and observe traffic of 1 website	1		3	Contd..	1		2
			5	**CIE 3 – Written and Practice Test**				Assessment Review and corrective action			3
	3,4	2,3, 4	6	**Industrial class :** How penetration testing is used in companies to improve their Security posture				Weekly Assignment			

9	3,4	2,3,4	1	Peer review Project status review		4		Cloud Penetration Testing Finding common cloud vulnerabilities Introduction to tools: Nessus, NMAP, Prowler	1		2
	3,4	2,3,4	2	Introduction to OSINT: Scanning the internet (example: Shodan) Google dorking Subdomain enumeration & asset monitoring	1		3	- Contd..	1		2
	3,4	2,3,4	3	- Hands-on exercise 1: Complete 3 server-side and 3 client-side topic from Burp Suite academy: https://portswigger.net/web-security/learning-path			4	- Contd..	1		2
	3,4	2,3,4	4	Hands-on exercise 2: Complete either the attacker or defender track in http://flaws2.cloud	1		3	- Contd..	1		2
			5	Development Assessment				Assessment Review and corrective action			3
	3,4	2,3,4	6	**Industrial class :** Bug bounty hunting				Weekly Assignment			

References :

1. **Basics of Web: https://www.hacker101.com/sessions/web_in_depth.html**
2. **NMAP Basics: https://www.freecodecamp.org/news/what-is-nmap-and-how-to-use-it-a-tutorial-for-the-greatest-scanning-tool-of-all-time/**
3. **HTTP Proxy:**
   a. **Burp Suite Essentials: https://www.youtube.com/playlist?list=PLoX0sUafNGbH9bmbIANk3D50FNUmuJIF3**
   b. **OWASP Zed Attack Proxy: https://www.zaproxy.org/getting-started/**

4. Vulnerability Scanning with Nessus: https://www.tenable.com/blog/how-to-run-your-first-vulnerability-scan-with-nessus **5. How to think like a Hacker: https://www.darkreading.com/vulnerabilities-threats/how-to-think-like-a-hacker** **The Cuckoo's egg (book)**											
10	3,4	2,3, 4	1	Peer review Project status review		4		Incident management introduction and objectives Stages and life cycle of incident management Tracking incidents Incident remediation Reporting and documentation Incident Closure Incident management teams and models Incident management services and integration tools - Best practices of Incident Management	1		2
	3,4	2,3, 4	2	Fundamentals · CIA · Threat Actors · Different kinds of hackers · Different kinds of teams – Blue, Red, Purple · Criminal Groups · Hactivist Groups · APT · Attack Vectors · Protect/Prevent · Detect/Respond · Trust Positive vs False Positive Data	1		3	Network · Quick revision of OSI model, encapsulation, IP, Subnets, TCP/UDP, well known ports, TCP/IP, Layer 2 Network Protocols · Quick revision of SMTP, HTTP, HTRPS/TLS, DNS Web technologies · Quick revision of DOM, CSS, Javascript, Ajax, MVC, Databases, SQL	1		2

				· Bits and Bytes · Charter Encoding (ASCII, UTF-8,Base64) · File Magic Bytes, Hashes · Imphash · Ssdeep Windows & Linux - · Quick revision on basic commands, important files and directories, windows registry and processes, Audit in Linux				Authentical protocols · Quick revision of Kerberos, SAML, OpenID, OAuth			
	3,4	2,3, 4	3	Understanding the tools and products used in any organization · Firewall, load balancers, proxy, email infrastructure, IDS, DNS, Ani-virus, Content Delivery Solutions, Malware Protection System, Endpoint Detection and Response, Netowrk Access Control, Placement of all devices in the organization – Tier1, Tier 2, Tier 3, DMZ	1		3	Continued..			3
	3,4	2,3, 4	4	SIEM · Understanding logs · Email, Proxy, DNS, IDS, Firewall, AV, EDR, Web application, Unix, Windows Attack Types/Vectors · Phishing, Malware, Distributed Denial of Service, Vulnerabilities (Infrastructure,	1		3	Basics of Incident Response · Alert processing · Procedures, runbooks and reference · Response options · Escalations · Incident categories · Incident Resolution Codes			3

				Application, third party), Web attacks, Misconfigurations, Brute force Attack Models · The cyber kill chain, MITRE ATT&CK Framework, Pyramid of Pain				Data Analysis · Data vs Intelligence · Indicators of compromise (IoCs) · Malware analysis · Accessing IoCs · Contacting threat intelligence Analysis tools · Anomaly · Domain tools · WhoIS · Passive DNS · Virus total · Dynamic File analysis			
			5	**CIE 4 – Written and Practice Test**				Assessment Review and corrective action			3
	3,4	2,3, 4	6	**Industrial class :** Handling Internal and external incidents Complexity of Incident management Demo of real world SOC				Weekly Assignment			

References :

1. https://nvlpubs.nist.gov/nistpubs/specialpublications/nist.sp.800-61r2.pdf

2. https://www.cisa.gov/uscert/bsi/articles/best-practices/incident-management
https://www.infotech.com/research/ss/develop-and-implement-a-security-incident-management-program

Lab : https://letsdefend.io											
11	3,4, 5	2,3, 4	1	Peer review Project status review		4		GRC (a) 1) Definition of GRC, introduction to IT governance (b) 2) Importance of GRC in cyber security (c) 3) Policies, processes and procedures (d) 4) Importance of checklists, templates and guidelines Enterprise risk management (a) Understanding risks that enterprises face – Operational Risks, Strategy Risks, Credit risks, Reputational risk, Market risks, Cyber risk (b) Cyber risk integration with Operational risk management	1		2
	3,4, 5	2,3, 4	2	- Introduction to basics of risk management Probability, Impact:-- [Financial, Legal, Regulatory, Reputational], Threat, Risk Assessment, Risk Treatment:-- [Accept, Mitigate, Transfer, Avoid], Residual risk, risk acceptance, Control objective, Controls:-- Preventive control, detective control and corrective control	1		3	Patch management Importance of patch management; pre-requisites and sample patch management process Vulnerability Management Vulnerability management lifecycle understanding – Identify, Evaluate, Remediate, Report	1		2

								Types of vulnerabilities – Hardware, Network, Operating systems, Application, Human and Process related vulnerabilities Vulnerability Management process			
	3,4, 5	2,3, 4	3	Practice Session: (a) Define one control statement each for access control, physical security and backup management (b) Explain one human vulnerability with example and how it can be exploited including remedial measures (c) Design IT asset register template with 5 sample rows populated with data Give examples for each category of classified information in an organization – do a combination of government organization and private organisation			4	ITIL Process overview – Incident Management, Problem Management, Change Management, Configuration Management, Release Management, Supplier Management, IT Security Management, Service level management, Capacity Management, Availability Management, Service continuity Management			3
			4	Security frameworks and Compliances			4	Cyber Security Governance:	1		2

				Introduction to standards/best practices/framework and its primary objective, ISO 27001, COBIT, PCI-DSS, Hi-Tech (HIPAA), NIST, IT Act 2000 (amendment in 2008), CERT-IN Guidelines. <u>Regulatory requirements</u> (a) RBI framework for banking (Cyber security framework, Gopalakrishna committee, UCB tiered framework) (b) SEBI framework for Securities market (c) Guidelines on Information and cyber security for insurers from IRDAI (d) TRAI requirements on security for telecom sector (e) GDPR				(a) Security organization, Responsibilities and authority, Management/Board responsibilities on cyber security, Resource allocation and cyber security budget management, Security Education, training and awareness, Cyber metrics, KRI/KPIs			
			5	**Development Assessment**				Assessment Review and corrective action		3	

	3,4	2,3, 4	6	**Industrial class :** 1. An industry perspective of GRC, VM and Security frameworks Demo of a GRC tool				Weekly Assignment (Suggestive Student Activities) (a) Identify use case of how changes or configuration in IT systems impacts security configuration resulting in cyber risk exposure (b) Design a sample cyber security dashboard for reporting to top management (c) Give two KRI examples each for the following domains: a. Patch Management b. Anti-virus management c. Change Management			

References :

1) https://www.armosec.io/blog/kubernetes-security-frameworks-and-guidance - Security Frameworks table
2) https://www.cybersaint.io/blog/what-is-grc
3) https://www.ibm.com/cloud/learn/grc
4) https://unece.org/fileadmin/DAM/trade/Publications/WP6_ECE_TRADE_390.pdf
5) https://www.pcisecuritystandards.org/documents/PCI_DSS-QRG-v3_2_1.pdf

6) https://www.nist.gov/

7) https://www.isaca.org/resources/cobit

8) https://www.meity.gov.in/writereaddata/files/itact2000/it_amendment_act2008.pdf

9) https://www.coso.org/SitePages/Guidance-on-Enterprise-Risk-Management.aspx?web=1

10) https://rbidocs.rbi.org.in/rdocs/notification/PDFs/NT41893F697BC1D57443BB76AFC7AB56272EB.PDF

11) https://rbidocs.rbi.org.in/rdocs/notification/PDFs/LBS300411F.pdf

1) https://rbidocs.rbi.org.in/rdocs/notification/PDFs/NOTI129BB26DEA3F5C54198BF24774E1222E61A.PDF

14) https://www.sebi.gov.in/legal/circulars/dec-2018/cyber-security-and-cyber-resilience-framework-for-stock-brokers-depository-participants_41215.html

15) https://www.sebi.gov.in/sebiweb/home/HomeAction.do?doListing=yes&sid=1&ssid=6&smid=0

16) https://www.aicofindia.com/AICEng/General_Documents/Notices%20And%20Tenders/IRDAI-GUIDELINES.pdf

17) https://www.irdai.gov.in/ADMINCMS/cms/whatsNew_Layout.aspx?page=PageNo4315&flag=1

18) https://www.rapid7.com/fundamentals/patch-management/

19) https://www.rapid7.com/fundamentals/vulnerability-management-and-scanning/

1)18. https://www.techtarget.com/searchsecurity/tip/IT-security-frameworks-and-standards-Choosing-the-right-one

21)https://www.irdai.gov.in/ADMINCMS/cms/Uploadedfiles/07.04.2017-Guidelines%20on%20Information%20and%20Cyber%20Security%20for%20insurers.pdf https://www.trai.gov.in/sites/default/files/RecommendationDataPrivacy16072018_0.pdf											
12	3,4,5	2,3,4	1	Peer review Project status review		4		DevOps and Security Challenges Understand the Core Principles and Patterns behind DevOps Recognize how DevOps works and identify keys to success	1		2
	3,4,5	2,3,4	2	Secure DevOps tools and workflows Conduct effective risk assessments and threat modeling in a rapidly changing environment Design and write automated security tests and checks in CI/CD Understand the strengths and weaknesses of different automated testing approaches in Continuous Delivery Inventory and patch your software dependencies Wire security scanning into Jenkins, Code Pipeline, and Azure DevOps workflows	1		3	Pre-Commit Security Controls Rapid Risk Assessment Git Hook Security Code Editor Extensions Branch Protections CodeOwners Peer Reviews Commit Security Controls Static Analysis Security Testing Component Analysis	1		2
	3,4,5	2,3,4	3	Secrets Management Managing secrets in CI / CD			4	Cloud Infrastructure as Code			3

				Azure Key Vault AWS SSM Parameter Store AWS Secrets Manager HashiCorp Vault				Introduction to Cloud Infrastructure as Code AWS Cloud Formation Terraform Deploying Cloud Infrastructure as Code security analysis			
	3,4, 5	2,3, 4	4	Configuration Management as Code Automating Configuration Management in CI / CD Using Ansible to Configure Virtual Machines Building Gold Images with Vagrant and Packer Certifying Gold Images with InSpec	1		3	Container Security Dockerfile and BuildKit Security Base Image Hardening with Hadolint and Conftest Container Image Security Scanning Container Images with Docker Scan and Trivy Container Registry Security Container Scanning with AWS ECR and Azure ACR Container Runtime Security Exercises Attacking the DevOps Toolchain Version Control Security Automating Static Analysis Protecting Secrets with Vault Infrastructure as Code Network Hardening Gold Image Creation Container Security Hardening	1		2

			5	**CIE 5 – Written and Practice Test**				Assessment Review and corrective action				
			6	Industry Class :	2		3					
13			1	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.				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.			

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

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 duration 3hr. Max marks 100		**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 with class / examiner**	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**
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 to clarify understanding	**Questions and discussions addressed important superficial issues of the problem statement Limited use of activities to clarify understanding**	Little or no attempt to engage the class / examiner in demonstrating their learning	Did not engage the class / examiner and poor listening skills	**3**
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	**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**

	reasoning beyond the class learning. 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 /	**The newly discovered**	The newly discovered processes	The newly discovered processes / models /	The newly discovered	No new processes /	**5**

models / approaches	**processes / models / approaches are of good quality and relevant**	/ models / approaches are of appropriate quality but limited relevance	approaches have limited application but relevant to the problem	processes / models / approaches has restricted application	models / 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: Cyber Security	**Max Marks: 100**
Course Code: 20CS54I	**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	**Cyber Security**	**Max Marks**	**30**
Course Code	**20CS54I**	**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
12.	**Computers**	Intel i7, 4GB RAM, 500GB SSD	**20**
13.	**Broadband connection**		