Government Polytechnic, Mumbai

Department of Computer Engineering

P-23 Scheme

Semester V

(Course Contents)

Programme: Diploma in Computer Engineering

(Sandwich Pattern)

Government Polytechnic, Mumbai
(Academically Atonoums Institute, Government of Maharashtra)
Programme: Diploma in Computer Engineering (Sandwich Pattern)

Learning and Assessment Scheme | **With Effect From Academic Year : 2023-24**
Duration Of Programme : 6 | **Scheme : P23**
Semester : FIFTH | **Duration : 16 WEEKS**

Sr No	Course Title	Course Type	Course Code	Total IKS Hrs for Sem	Learning Scheme					Credits	Assesment Scheme														
					Actual Contact Hrs/Week			Self Learning(TW + Assignment)	Notional Lerning Hrs / Week		Paper Duration (hrs.)	Theory						Based on LL & TL Practical					Based on Self Learning		Total Marks
												FA-TH	FA-TH	SA-TH	Total			FA-PR		SA-PR			SLA		
												T1	T2	Max	Max	Min		Max	Min	Max		Min	Max	Min	
					CL	TL	LL					Max	Max							PR	OR				
1	Fundamentals of AI and ML Algorithms	DSC	CO23113	–	3	–	4	1	8	4	2.30	20	20	60	100	40	25	–	25#	–	10	25	–	175
2	Computer Security	DSC	CO23114	–	3	–	2	1	6	3	2.30	20	20	60	100	40	25	–	25#	–	10	25	–	175
3	Software Testing	DSC	CO23115	–	3	–	2	1	6	3	2.30	20	20	60	100	40	25	–		25#	10	25	–	175
4	Entrepreneurship and Start-ups	INP	IT23402	–	1	–	2	1	4	2	–	–	–	–	–	–	25	–	–	25#	10	25	–	75
5	Major Project	INP	CO23402	–	–	–	4	4	8	4	–	–	–	–	–	–	50	–	–	50#	20	50	–	150
6	Cloud Computing	DSE	CO23204	–	2	–	2	–	4	2	–	–	–	–	–	–	50	–	50#	–	20	–	–	100
	Data Analytics using R		CO23205															–					–	
	Microcontroller and Embedded Systems		CO23206															–					–	
7	MOOC (Interdisciplinary)	INP	CO23605	–	–	–	–	4	4	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Total			–	**12**	–	**16**	**12**	**40**	**20**					**300**		**200**		**75**	**125**		**150**		**850**

Abbreviations : CL-Classroom Learning, TL-Tutorial Learning, LL- Laboratory Learning, FA-Formative Assessment, SA-Summative Assessment, IKS-Indian Knowledge System, SLA-Self Learning Assessment

Legends :@ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination

Note : 1. FA-TH represents two class tests of 20 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then candidate shall be declared as fail & will have to repeat & resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.*16 Weeks
5. 1 credit is equivalent to 30 Notional hrs. 6. *Self learning hours shall not be reflected in the TimeTable.

Course Category : Discipline Specific CourseCore(DSC): 5, Discipline Specific Elective (DSE):0,Value Education Course(VEC):1, Intern./Apprenti./Project./ Community(INP):0, Ability Enhancement Course (AEC) : 0, Skill Enhancement Course (SEC) : 1, Interdisciplinary Elective (IE) : 0

Department Coordinator, Curriculum Development, Dept. of Computer Engineering
Head of Department, Dept. of Computer Engineering
In-Charge, Curriculum Development Cell
Principal, Government Poly. Mumbai

Programme : Diploma in Computer Engineering and Information Technology (Sandwich Pattern)													
Course Code: CO23113					**Course Title: Fundamentals of AI and ML Algorithms**								
Compulsory / Optional: Compulsory													
Teaching Scheme and Credits						**Examination Scheme**							
						FA-TH		**SA-TH**		**SA**			
CL	**TL**	**LL**	**SLH**	**NLH**	**Credits**	**TH1**	**TH2**	**(2Hrs. 30 Min)**	**FA-PR**	**PR**	**OR**	**SLA**	**Total**
3	--	4	1	8	4	20	20	60	25	25#	--	25	175

Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL- Laboratory Learning, SLH- Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, SLA- Self Learning Assessment.
Legends: @ Internal Assessment, # External Assessment, *# Online Examination, @$ Internal Online Examination.

Note:

1. FA-TH represents Total of two class tests of 20 marks each conducted during the term.
2. FA-PR represents Tutorial Term work of 25 Marks
3. SLA represents self-learning Assessment of 25 Marks
4. SA-TH represents the end term examination of 60 Marks
5. SA-PR represents the end term examination of 25 Marks.

I. Rationale

Artificial Intelligence (AI) includes the ability to carry out operations that have historically required human intelligence, such as speech recognition, visual perception, language translation, and decision- making. Machine Learning (ML) is a subset of Artificial Intelligence (AI) which is the study of patterns and structures in data analysis and interpretation. Students will be able to apply AI/ML techniques to real- world problems through projects and case studies.

II. Industry/Employer Expected Outcome

Engineers applying AI & ML concepts should proficiently solve real-world problems, enhancing decision- making, design and innovation with precision and efficiency.

III. Course Outcomes

Students will be able to achieve & demonstrate the following COs on completion of **course** based learning.

CO1	Use basic concepts of AI & ML.
CO2	Implement relevant search algorithms as applicable to Artificial Intelligence.
CO3	Apply method for knowledge representation to make informed decisions for various applications.
CO4	Analyze different forms of data with respect to different phases of Machine Learning.
CO5	Create data model for Machine Learning Algorithms.
CO6	Classify the data by performing different Regression Techniques

IV. Course Content Details:

Unit No.	Theory Learning Outcomes (TLO's) aligned to CO's.	Topics / Sub-topics
1	TLO 1.1 Describe the different terminologies of AI. TLO 1.2 List the different types of AI agent.	**Unit - I Introduction to AI** 1.1 Basic Definition and Terminology: a. Foundation and Evaluation of AI b. Scope of AI, c. Overview of AI Problems d. Components of AI e. Types of AI f. Application of AI g. AI vs. ML 1.2 Intelligent Agent in AI: a. Types of AI agent b. Concept of Rationality c. Nature of environment, d. Structure of agents e. Turing Test in AI
	Course Outcome: CO1	**Teaching Hours: 06 Marks: 06**

2	TLO 2.1 State the different types of search algorithm. TLO 2.2 Explain different Heuristic Search Techniques. TLO 2.3 Describe Local Search algorithms.	**Unit – II Problem Solving** 2.1 Search Algorithms in Artificial Intelligence: a. Terminologies b. Properties of search Algorithms c. Types of search algorithms: uninformed search and Informed Search, State Space Search. 2.2 Heuristic Search Techniques: a. Generate-and-Test; b. Hill Climbing. c. Properties of A* algorithm, d. Depth-First Search, e. Best-First Search, f. Problem Reduction 2.3 Beyond Classical Search: a. Local search algorithms and optimization problem. b. Local search in continuous spaces c. Searching with nondeterministic action and partial observation. d. Online search agent and unknown environments
	Course Outcome: CO2	**Teaching Hours: 08 Marks: 12**
3	TLO 3.1 Describe the architecture of knowledge-based agent in AI. TLO 3.2 Explain the different types of Reasoning in AI. TLO 3.4 Apply probabilistic reasoning.	**Unit - III Knowledge and Reasoning** 3.1 Knowledge-Based Agent in Artificial intelligence: a. Architecture, b. approaches to designing a knowledge-based agent c. Techniques of knowledge representation, Propositional logic, d. Rules of Inference, e. First-Order Logic, f. Forward Chaining & Backward Chaining in AI

		3.2 Reasoning in Artificial intelligence: a. What is Reasoning b. Types of Reasoning 3.3 Probabilistic reasoning in AI: a. Uncertainty b. Causes of Uncertainty c. Need of probabilistic reasoning in AI
	Course Outcome: CO3	**Teaching Hours: 06 Marks: 12**
4	TLO 4.1 Differentiate between AI and ML. TLO 4.2 Explain different phases of Machine Learning Life Cycle. TLO 4.3 Explain different forms of data. TLO 4.4 Explain different data preprocessing methods. TLO 4.6 Explain the techniques of Data Cleaning.	**Unit - IV Introduction to ML** 4.1 History and Evaluation of ML, AI vs ML 4.2 Machine Learning Life Cycle: a. Gathering data, b. Data Preparation, c. Data Wrangling, d. Data Analysis, e. Train Model, f. Test Model, g. Deployment 4.3 Different forms of Data: a. Statistics b. Data Mining, c. Data Analytics, d. Statistics Data, e. Statistics vs. Data Mining, f. Data Analytics vs Data Science 4.4 Dataset for ML: Training Dataset, Testing Datasets, Training vs Testing 4.5 Data Cleaning: Missing Data, Outliers
	Course Outcome: CO4	**Teaching Hours: 07 Marks: 10**

5	TLO 5.1 Differentiate characteristics of Supervised and Unsupervised Learning. TLO 5.2 Explain Supervised Machine Learning Algorithms. TLO 5.3 Explain Unsupervised Machine Learning Algorithms. TLO 5.4 Test the validity of Datasets by applying the Cross-Validation.	**Unit - V Types of Learning** 5.1 Types of Learning: a. Supervised, b. Unsupervised, c. Semi- Supervised Learning 5.2 Supervised Learning: a. Learning a Class from Examples, b. Introduction of different types of Supervised Machine Learning Algorithms 5.3 Unsupervised Learning: a. Introduction of different types of Unsupervised Learning Algorithm: 5.4 Model Evaluation: a. Training Vs. Testing b. Positive and Negative class cross-validation
	Course Outcome : CO5	**Teaching Hours: 08 Marks: 10**
6	TLO 6.1 Describe different types of Regression. TLO 6.2 Describe the assessing performance of Regression TLO 6.3 Differentiate between overfitting and underfitting by example. TLO 6.4 Explain the logistic regression techniques. TLO 6.5 Create classification matrix for given Dataset	**Unit - VI Classification and Regression** 6.1 Linear Regression: a. Assessing performance of Regression – b. Error measures, c. Overfitting and Underfitting, d. Catalysts for Overfitting 6.2 Multiple Linear Regression: a. Multiple Linear regression equation, b. Implementation of multiple linear regression 6.3 Metrics for Regression: a. Mean Squared Error (MSE), b. Root Mean Squared Error (RMSE), c. Mean Absolute Error (MAE)

		6.4 Logistic Regression: a. Binary and Multiclass Classification, b. Assessing Classification Performance, c. Handling more than two classes, d. Multiclass Classification: One vs One, One vs Rest 6.5 Metrics for Classification: Confusion Matrix, AUC/ROC Curve, F1 Score, Accuracy, Precision, Recall
	Course Outcome: CO6	**Teaching Hours: 10** **Marks: 10**

V. Laboratory Learning Outcome and Aligned Practical / Tutorial Experiences.

Sr. No.	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles / Tutorial	Number of hrs.	Relevant COs
1	LLO 1.1 Install given IDE for python.	Installation of Python IDE software Installation of Python "scikit learn" for ML. Use of google colab (https://colab.research.google.com/)	2	CO1
2	LLO 2.1 Learn libraries required for ML	Utilizing Python libraries like NumPy, Pandas, Scikit-learn, and Matplotlib for data manipulation and visualization	2	CO1
3	LLO 2.1 Implement Breadth First Search Algorithm.	Write program to Implement Breadth First Search Algorithm (Uninformed) in Python	4	CO2
4	LLO 4.1 Develop Depth First Search Algorithm.	Write program to implement Depth First Search Algorithm (Uninformed) in Python	4	CO2
5	LLO 5.1 Implement Greedy Best-First Search Algorithm.	Write program to implement Greedy Best-First (Informed Type) Search Algorithm in python	4	CO2
6	LLO 6.1 Develop A* search Algorithm.	Write program to implement A* search (Informed Type) Algorithm in Python	4	CO2
7	LLO 7.1 Analyze the process of Turing test for given Dataset.	Analyze the given Case study: How Turing test is performed between Responder and an Interrogator?	4	CO3
8	LLO 8.1 Analyze different datasets with respect to its use.	Explore different dataset finders e.g. Google Dataset Search, Kaggle, mendeley etc.	4	CO4

9	LLO 9.1 Build model on various data sets.	Build model on following data sets in various domains. a. Machine Learning data set: e.g. Credit Card Fraud Detection Dataset b. NLP data sets: eg. Twitter Dataset, HotspotQA Dataset	4	CO4
10	LLO 10.1 Develop program based on training and testing datasets.	Write a program in python to split any data set into train and tests sets	4	CO4
11	LLO 11.1 Analyze the mail filtering process.	Case Study of Email spam and non-spam filtering using Machine Learning	4	CO4,5
12	LLO 12.1 Develop simple ChatBot	Make a simple program that can talk to you and answer questions. You can start with basic rules and then try to make it smarter by teaching it new things.	4	CO4,5
13	LLO 13.1 Implement Linear Regression	Implement Simple Linear Regression using python	4	CO6
14	LLO 14.1 Implement Multiple Regression	Implement Multiple Linear Regression using python	4	CO6
15	LLO 15.1 Develop program to find cross validation score	Write program to calculate cross validation score for any Dataset-like IRIS	4	CO6
16	LLO 16.1 Implement program for confusion matrix.	Write program to create confusion matrix to calculate different measures to quantify the quality of the model	4	CO6

VI. Suggested Micro Project / Assignment/ Activities for Specific Learning / Skills Development (Self Learning):

Micro Project:

- Develop a micro project for Movie Recommendation System: Use a dataset like the Movie Lens dataset, preprocess the data (split into training and test sets), train a collaborative filtering model and generate and evaluate recommendations for users.
- Build a system that can understand and read handwritten numbers, like from 0 to 9.
- Suggest songs to people based on what they like and listen to
- Analyze articles and try to figure out if they are true or made up.
- Develop a micro project for Simple Chatbot: define a set of intents and responses and train a dataset to classify user inputs.
- Develop a micro project for Spam Email Classifier in which collect a dataset of labeled emails (spam or not spam), pre-process the text data (remove stop words, tokenize, etc.)
- Case study on Natural Language Generation (NLG) for E-commerce Product Description.

VII. Specification Table

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Introduction to AI	2	4	-	06
2	Problem Solving	4	4	4	12
3	Knowledge and Reasoning	4	4	4	12
4	Introduction to ML	2	4	4	10
5	Types of Learning	2	4	4	10
6	Classification and Regression	2	4	4	10
Total		16	24	20	60

VIII. Suggested COs - POs Matrix Form

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Lifelong Learning	PSO- 1	PSO- 2	PSO- 3
CO1	2	1	2	-	2	2	2	1	-	1
CO2	2	2	2	-	2	2	2	2	-	3
CO3	2	1	2	-	2	2	2	2	-	2
CO4	2	2	2	-	2	2	2	2	-	2
CO5	2	2	2	-	2	2	2	2	-	3

Legends:- High:03, Medium:02,Low:01, No Mapping: -

*PSOs are to be formulated at institute level

IX. Suggested Learning Materials / Books

Sr. No.	Author	Title	Publisher with ISBN Number
1	Stuart Russell and Peter Norvig, Editors	Artificial Intelligence A Modern Approach Third edition	Pearson Education, Inc ISBN-13: 978- 0-13-604259-4 ISBN-10: 0-13-604259-7
2	Dr. Jeeva Jose	Introduction to Machine Learning with Python	Khanna Book Publishing Co.(P) Ltd. ISBN 9789389139068 ISBN 9789389139068
3	Dipanjan Sarkar Raghav Bali Tushar Sharma	Practical Machine Learning with Python A Problem-Solver's Guide to Building Real- World Intelligent Systems	Apress publication ISBN-13 (pbk): 978-1-4842-3206-4 ISBN-13 (electronic): 978-1-4842-3207-1
4	Andreas C. Müller & Sarah Guido	Introduction to Machine Learning with Python	O'Reilly Media, Inc ISBN 9352134575 ISBN 9789352134571
5	Manaramjan Pradhan, U Dinesh Kumar	Machine Learning using Python	Wiley India ISBN 978-81-265-7990-7 ISBN 9 788126 579907

X. Learning Websites & Portals:

Sr. No.	Link / Portal	Description
1	https://www.python.org/downloads/	Python IDE download
2	https://www.pdfdrive.com/machine-learning-step-by-step-guide	-
3	https://www.geeksforgeeks.org/how-to-install-python-pycharm- on- windows	Guidelines for Installation of python
4	https://stackabuse.com/courses/graphs-in-python-theory-and-i mplementation/lessons/a-star-search-algorithm	A* algorithm
5	https://www.javatpoint.com/turing-test-in-ai	Turing test
6	https://www.v7labs.com/blog/best-free-datasets-for-machine-l earning	Datasets
7	https://www.geeksforgeeks.org/how-to-split-a-dataset-into-tr ain-and-test- sets-using-python	Training and Testing Dataset
8	https://towardsdatascience.com/email-spam-detection-1-2-b0e0 6a5c0472	Filtering Dataset

XI. Academic Consultation Committee/Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organization
1	Ms.Ashatai V Wankar	Lecturer in Computer Engineering	Govt. Polytechnic Mumbai
2	Mr. Priyanka Khadtare	Software Developer	Nykaa Pvt. Ltd.
3	Mrs. Neha H Vachani	Lecturer in Computer Engineering	Govt. Polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of Computer Engineering

Head of Department
Department of Computer Engineering

I/C, Curriculum Development Cell

Principal

Programme : Diploma in Computer Engineering													
Course Code: CO23114						**Course Title: Computer Security**							
Compulsory / Optional: Compulsory													
Teaching Scheme and Credits						**Examination Scheme**							
CL	**TL**	**LL**	**SLH**	**NLH**	**Credits**	**FA-TH**		**SA-TH (2Hrs.30 Min)**	**FA-PR**	**SA**		**SLA**	**Total**
						TH1	**TH2**			**PR**	**OR**		
03	**-**	**02**	**01**	**06**	**03**	**20**	**20**	**60**	**25**	**25#**	**-**	**25**	**175**

Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL- Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA - Summative assessment, SLA- Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# Online Examination, @$ Internal Online Examination

Note:
1. FA-TH represents Total of two class tests of 20 marks each conducted during the term.
2. FA-PR represents Tutorial Term work of 25 Marks
3. SLA represents self-learning Assessment of 25 Marks
4. SA-TH represents the end term examination of 60 Marks

I. Rationale

The aim of the course is to familiarize students with the basic problems of computer security. They will include the risks of information systems in the context of confidentiality, integrity and availability of information security policy development issues system, elements of cryptography, issues of electronic signatures and public key infrastructure, basic models of authentication, access control policies, security, communication protocols and application services.

II. Industry / Employer Expected Outcome

Students will be able to

a) Protect an organization's computer systems, networks, and data from cyber threats.

b) Develop secure system by using security algorithms and tools.

III. Course Outcomes: Students will be able to

CO1	Identify the potential threats to confidentiality, integrity and availability of Computer Systems
CO2	Use cryptography algorithms and protocols to achieve Computer Security
CO3	Build systems that are more secure against attacks.
CO4	Apply security principles to secure Operating Systems and applications.

IV. Course Content Details:

Unit No.	Theory Learning Outcomes (TLO's)aligned to CO's.	Topics / Sub-topics
1	TLO 1.1 Understand the concept of computer security. TLO 1.2 Understand the principles of security. TLO 1.3 Understand various types of security attacks	**Introduction to computer security and security trends.** 1.1 Definition of Computer Security, Need for security, Security basics: Confidentiality, Integrity, Availability, Accountability, Non-repetition. Example of Security, Challenges for security. 1.2 Risk and Threat Analysis: Assets, Vulnerability, Threats, Risks, Counter measures. 1.3 Threat to Security: Viruses and Worms, Intruders, Insiders, Criminal organizations, Terrorists, Information warfare, Avenues of attack, steps in attack 1.4 Security attacks: Active and Passive attacks, Denial of service, backdoors and trapdoors, sniffing, spoofing, man in the middle, replay, TCP/IP Hacking, encryption attacks, Keyloggers 1.5 Malware : Viruses, Logic bombs.
	Course Outcome: CO1	**Teaching Hours: 06** **Marks: 08**

2	TLO 2.1 Understand and apply core concepts of identification, authentication TLO 2.2 Understand the importance of security awareness TLO 2.3 Identify advantages and limitations of biometric authentication.	**Identification, Authentication and Operational Security** 2.1 Username and password, Managing passwords, choosing password. 2.2 Role of people in Security: Password selection, Piggybacking, Shoulder surfing, Dumpster diving, Installing unauthorized software/hardware, Access Nonemployees, Security awareness, Individual User responsibilities 2.3 Access controls: Definition, principle, policies: DAC, MAC, RBAC. 2.4 Biometrics: fingerprints, handprints, Retina patterns, voice patterns, signature and writing patterns.
	Course Outcome: CO1	**Teaching Hours: 06** **Marks: 10**
3	TLO 3.1 Understand the terminologies and methods of cryptography TLO 3.2 Understand & apply different cryptography algorithms. TLO 3.3 Understand the concept of digital signature & steganography	**Cryptography** 3.1Introduction: Cryptography, Cryptanalysis, Cryptology, Substitution techniques: Caesar's cipher, monoalphabetic and polyalphabetic, one-time pad. 3.2 Transposition techniques – Rail fence technique, simple columnar 3.3 Hashing – concept 3.4 Symmetric and asymmetric cryptography: Introduction to Symmetric encryption, Data Encryption Standard (DES), International Data Encryption Algorithm (IDEA), Advance Encryption Standard (AES-128) Asymmetric key Cryptography: RSA (Rivest–Shamir–Adleman) algorithm, Diffie–Hellman key exchange (DH). 3.5 Digital Signature 3.6 Introduction to steganography
	Course Outcome: CO2	**Teaching Hours: 13** **Marks: 20**

4	TLO 4.1 Understand the working of Firewall & Kerberos TLO 4.2 Understand an Intrusion detection systems with it's types. TLO 4.3 Understand E-mail security.	**Computer Security Technology and Intrusion Detection** 4.1 Firewalls: Need for Firewall, limitations, characteristics. Types of Firewalls: Hardware, Software, Packet filter, Proxy Server, Hybrid, Application gateways, circuit level gateway, Implementing Firewall. 4.2 Kerberos: Working, AS, TGS, SS 4.3 Intrusion Detection: Intrusion detection systems (IDS), host-based IDS, network-based IDS, Honey pots. 4.4 Email security: Email security standards: Working principle of SMTP, PGP, S/MIME.
	Course Outcome: CO3	**Teaching Hours : 08** **Marks: 08**
5	TLO 5.1 Understand the concept of computer security TLO 5.2 Understand cyber laws. TLO 5.3 Understand procedure & techniques of Cyber forensics.	**Cyber Security** 5.1 Introduction to Cyber Crimes – Hacking, Cracking, Viruses, Virus Attacks, Pornography, Software Piracy, Intellectual property, Legal System of Information Technology, Mail Bombs, Bug Exploits, Cyber Crime Investigation 5.2 Introduction Cyber Laws- Introduction to IT act 2000 and IT act 2008, Introduction to the cyber laws. 5.3 Cyber Forensics: Introduction to Cyber Forensic, Forensic Tools and Techniques, Investigating the Crime Scene, Rules of Evidence.
	Course Outcome: CO3	**Teaching Hours: 06** **Marks: 06**

6	TLO 6.1 Understand application security TLO 6.2 Understand web security TLO 6.3 Understand & apply database security	**Application, Web & Database Security** 6.1 Application hardening, application patches, web servers, active directory. 6.2 Web security threats, web traffic security approaches, Secure socket layer and transport layer security, secure electronic transaction 6.3 Database Security: SQL Injection, Web Application & SQL Injection, SQL Injection prevention
	Course Outcome: CO4 **Teaching Hours: 06** **Marks: 08**	

V. Laboratory Learning Outcome and Aligned Practical / Tutorial Experiences.

Sr No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles / Tutorial	Number of hrs.	Relevant COs
1	LLO 1.1. Demonstrate the use of malware and virus detection tools	Identify malwares and viruses from your system by using any malware/virus detection tool.	02	CO1
2	LLO 2.1 Learn use of Keylogger	Use keylogger to get confidential data.	02	CO1
3	LLO 3.1 Demonstrate the use of Cryptool	Create Digital Signature document using Cryptool	04	CO2
4	LLO 4.1 Implement substitution technique.	Implement Caesar cipher algorithm	02	CO2
5	LLO 5.1. Implement transposition technique	Implement rail fence technique & Simple columnar techniques.	04	CO2
6	LLO 6.1 Apply RSA algorithm	Encrypt & decrypt a plaintext using RSA algorithm.	02	CO2
7	LLO 7.1 Apply DH-key algorithm	Perform key exchange using DH algorithm	02	CO2
8	LLO 8.1Use tool for packet filtering	Filter packets according to protocol using any packet filtering tool.	02	CO3
9	LLO 9.1 Demonstrate the use of following tools for network security	Demonstrate the use of following tools: • Samspade • Nslookup • Whois • Tracert	04	CO3

10	LLO 10.1. Able to demonstrate buffer overflow attack	Demonstrate buffer overflow attack.	02	CO3
11	LLO 11.1. Demonstrate SQL injection	Perform SQLinjection on any website (HTMLget)	02	CO4
12	LLO 12.1.0 Able to analyze a real-world cybercrime case.	Case study of cyber-crime, where the attacker has performed any kind of cyber-attack. Prepare a report and also list the laws that will be implemented on attacker.	02	ALL

VI. Suggested Micro Project / Assignment/ Activities for Specific Learning / Skills Development (Self Learning):

1. Create a tool to find bugs on website.
2. Create a script that can detect the presence of a keylogger on endpoint.
3. Create a Phishing Awareness Simulation Tool

VII. Specification Table:

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Introduction to computer security and security trends.	4	4	--	8
2	Identification, Authentication and Operational Security	4	4	2	10
3	Cryptography	4	4	12	20
4	Computer Security Technology and Intrusion Detection	2	4	2	8
5	Cyber Security	2	4	--	6
6	Application, Web & Database Security	2	4	2	8
	Total	**18**	**24**	**18**	**60**

VII. Assessment Methodologies/Tools

Formative Assessment (Assessment for Learning)

- TH- Progressive /Periodic Test each of 20 Marks
- TL - Continuous Assessment of Tutorials for 25 Marks
- SL - Continuous Assessment of Self Learning for 25 Marks

Summative Assessment (Assessment of Learning)

- **TH -** Term End examination of 60 Marks

VIII. Suggested COs - POs Matrix Form

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Lifelong Learning	PSO- 1	PSO-2	PSO-3
CO1	2	2	1	2	2	-	3	1	2	-
CO2	2	1	2	2	2	2	3	1	3	3
CO3	2	1	2	3	2	2	3	1	3	3
CO4	2	1	2	3	2	2	3	1	3	3

Legends:- High:03, Medium:02,Low:01, No Mapping: -

*PSOs are to be formulated at institute level

IX. Suggested Learning Materials / Books

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
01	Cryptography and Network Security	Atul Kahate	Tata McGraw Hill
02	Computer Security Principles and Practices	William Stallings,	Pearson Education
03	Principles of Computer Security + and Beyond	Wm. Arthur Conkin	Mc Graw Hill

X. Learning Websites & Portals

1. http://www.pgpi.org/doc/pgpintro
2. http://www.emailtrackerpro.com
3. http://www.kmint21.com
4. http://www.jjtc.com/Steganography/tools.ht

XI. Academic Consultation Committee/Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organization
1	Mr. Atul Jadhav	Director	Cybernist Pvt Ltd.
2	Mrs. Madhuri Arde	Lecturer in Information Technology	Govt. Polytechnic Kolhapur
3	Mrs. R. V. Molawade	Lecturer in Computer Engineering	Govt. Polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of Computer Engineering

Head of Department
Department of Computer Engineering

Principal

I/C, Curriculum Development Cell
Government Polytechnic, Mumbai

Government Polytechnic, Mumbai

Programme : Diploma in Computer Engineering (Sandwich Pattern)													
Course Code: CO23115						**Course Title: Software Testing**							
Compulsory / Optional: Compulsory													
Teaching Scheme and Credits						**Examination Scheme**							
CL	**TL**	**LL**	**SLH**	**NLH**	**Credits**	**FA-TH**		**SA-TH (**2Hrs.30 Min**)**	**FA-PR**	**SA**		**SLA**	**Total**
						TH1	**TH2**			**PR**	**OR**		
3	--	2	1	6	3	20	20	60	25	--	25#	25	175

Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL- Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA - Summative assessment, SLA- Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# Online Examination, @$ Internal Online Examination

Note:

1. FA-TH represents Total of two class tests of 20 marks each conducted during the term.
2. FA-PR represents Tutorial Term work of 25 Marks
3. SLA represents self-learning Assessment of 25 Marks
4. SA-TH represents the end term examination of 60 Marks

I. Rationale

Software Testing is the process of verifying a system with the purpose of identifying any errors, gaps or missing requirement versus the actual requirement. Software Testing is important because software bugs could be expensive or even dangerous. Learning this subject will help students to plan effective test approach and to find bugs in earlier phase of Software Development.

Also, this course will introduce Automation testing which will utilize student's creativity to explore new ways to test a system, and thus student will spend less time as a tester and more time being the Quality Analyst.

II. Industry / Employer Expected Outcome

Engineers applying Software Testing concepts and Tools to proficiently find and solve errors, gaps or missing requirement to enhancing Software or product with precision and efficiency.

III. Course Outcomes: Students will be able to achieve & demonstrate the following COs on completion of course based learning.

CO1	Describe the concept of Software Testing
CO2	Apply White Box Testing.
CO3	Apply Black Box Testing.
CO4	Prepare Test Plan, Test Case and bug Report.
CO5	Apply Special tests.
CO6	Automate Software Testing and Test software for performance measures using automated testing tools.

IV. Course Content Details:

Unit No.	Theory Learning Outcomes (TLO's)aligned to CO's.	Topics / Sub-topics
1	**TLO 1.1.** State the impact of Bugs **TLO 1.2.** Describe Software Testing, Role of Testing, Software Testing Myths. **TLO 1.3.** Use of STLC and V model. **TLO 1.4.** Give Characteristics of a good Software Tester. **TLO 1.5.** Explain the Precision and Accuracy, Verification and Validation	**Introduction to Software Testing** 1.1 Software Testing Background 1.1.1 Bug 1.1.2 Reasons behind occurrence of Bugs 1.1.3 Cost of Bugs. 1.2. Concept Software Testing, Role of Testing, Software Testing Myths. 1.3 Objectives of Testing 1.4 STLC (Software Testing Life Cycle) 1.5 V model of software testing 1.6 Advanced V model 1.7 Characteristics of a good Software Tester 1.8 Software Testing Terms: Precision and Accuracy, Verification and Validation
	Course Outcome: CO1	**Teaching Hours: 06** **Marks: 08**

2	**TLO 2.1.** State the impact of White Box Testing **TLO 2.2.** Describe Classification of White Box Testing. **TLO 2.3.** Use of White Box Testing. **TLO 2.4**. Explain various techniques of White Box Testing. **TLO 2.5**. Explain need of White box Testing	**White-Box Software Testing** **2.1 Concept and Need of WBT,** **2.2 Classification of White Box Testing** • Path Testing • Loop Testing • Conditional Testing • Unit Testing • Integration Testing with sub- types **2.3 Techniques for White Box Testing** • Statement Coverage • Branch Coverage • Path Coverage • Decision Coverage • Condition Coverage • Control Flow Testing • Data Flow Testing
	Course Outcome: CO2	**Teaching Hours: 08** **Marks: 12**
3	**TLO 3.1.** Explain the concept of Black-Box Testing and justify its importance in software development and quality assurance. **TLO 3.2.** Describe functional testing and apply it to verify software features based on functional requirements. **TLO 3.3**. Explain the purpose of regression testing and perform test cases to validate unchanged functionalities after modifications. **TLO 3.4.** Apply equivalence partitioning to reduce the number of test cases while maintaining effective test coverage. **TLO 3.5.** Identify common software design or implementation patterns and validate them using grey box testing approaches.	**Black-Box Software Testing** **3.1 Concept and Need of BBT** **3.2 Classification of Black Box Testing** 3.2.1 Functional Testing 3.2.2 Regression Testing 3.2.3 Nonfunctional Testing **3.3 Techniques for Black Box Testing** 3.3.1 Equivalence Partitioning 3.3.2 Boundary Value Analysis 3.3.3 Requirement-based testing 3.3.4 Positive and Negative Testing **3.4 Grey Box Testing: Concept and Need of GBT** **3.5 Techniques for Grey Box Testing** 3.5.1 Matrix Testing 3.5.2 Pattern 3.5.3 Regression Testing
	Course Outcome: CO3	**Teaching Hours: 08** **Marks: 12**

4	**TLO 4.1.** Understand the **purpose and importance** of test planning in the software testing lifecycle. **TLO 4.2.** Explain the **concept and purpose** of an RTM. **TLO 4.3**. Create **RTM** linking requirements to test cases. **TLO 4.4.** Understand/Explain the complete **bug/defect life cycle** **TLO 4.5.** Use a **bug tracking system** to log, update, and track defects and prepare and understand a **Test Incident Report**	**Test Planning, Documentation and Bug Reporting:** **4.1 Test Plan: Goal of the Test Planning** • Resource requirements, • Tester Assignments, • Test schedule, • Test Case **4.2 Requirement Traceability Matrix.** **4.3 Getting bugs fixed, Bugs Life Cycle**. **4.4 Bug Tracking System** • Test Incident Report Manual Bug Reporting and Tracking.
	Course Outcome: CO4	**Teaching Hours : 06** **Marks: 08**
5	**TLO 5.1.** State **system testing** and explain its role in the software development lifecycle. **TLO 5.2.** Identify and describe various **types of system testing** and their objectives. **TLO 5.3**. Understand the purpose and types of **User Acceptance Testing**. **TLO 5.4.** Define and apply **acceptance criteria** and Explain the difference between **Alpha and Beta Testing**. **TLO 5.5.** Understand the purpose and execution of **specialized testing techniques** and apply appropriate test types based on context and software needs.	**Levels of Testing** **5.1 System Testing** • Recovery Testing, • Security Testing, • Performance Testing, • Stress Testing, • Usability Testing, • Compatibility Testing. **5.2 User Acceptance Testing** • Acceptance Criteria, • Alpha Testing, • Beta Testing **5.3 Special Tests** • Accessibility Testing, • Smoke Testing • Sanity Testing, • Usability Testing
	Course Outcome: CO5	**Teaching Hours: 9** **Marks: 10**
6	**TLO 6.1.** Identify the **drawbacks of manual testing**, such as time consumption, human error, and scalability issues. **TLO 6.2.** Understand why **automation is essential** in modern software testing. **TLO 6.3**. Evaluate situations to decide whether to use **manual or automated testing**. **TLO 6.4.** Identify factors to consider when **choosing a test automation tool**. **TLO 6.5.** Understand the **purpose and use cases** of Selenium WebDriver and JUnit.	**Automated Tools** 6.1 Limitations of Manual Testing and Need for Automated Testing 6.2 Benefits and limitations of Using Tools 6.3 When to Use Automated Test Tools 6.4 Selecting a Testing Tool 6.5 Automated Test Tools: Selenium WebDriver, JUnit. 6.6 Features and importance of these Test Tools.
	Course Outcome: C6	**Teaching Hours: 08** **Marks: 10**

V. Laboratory Learning Outcome and Aligned Practical / Tutorial Experiences.

Sr No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles / Tutorial	No. of hrs.	Relevant COs
1	Identify the **verification** (left side) and **validation** (right side) phases of the V-Model.	Apply V model for any Software product for preparing report.	02	CO1
2	Identify differences between White Box and Black Box Testing.	Apply techniques of White box Testing on Given Software system. (Students need to take their Project as a software system also each techniques need to be taken)	04	CO2
3	Apply Techniques of White Box Testing on a Given Software System	Apply techniques of White box Testing on Given Software system. E.g.1. Institute admission process 2. Medical Care center 3. Hostel Management system etc.	04	CO2
4	Apply Techniques of Black Box Testing on a Given Software System	Apply techniques of Black box Testing on Given Software system. (Students need to take their Project as a software system also each techniques need to be taken)	04	CO3
5	Apply Techniques of Black Box Testing on a Given Software System	Apply techniques of Black Testing on Given Software system. E.g.1. Institute admission process 2. Medical Care center 3. Hostel Management system etc.	04	CO3
6	Develop a comprehensive Test Plan document for their software project, including test objectives, scope, strategy, resources, schedule, test cases, and risk assessment.	Prepare Test Plan for your software project.	02	CO5
7	Identify the functional and non-functional system specifications of their software project and design test cases for applicable special tests such as smoke testing, sanity testing, usability testing, and accessibility testing.	Identify system specification & design test cases for special tests on your software project.	02	CO4
8	Explain the stages of the Bug Life Cycle and apply them by identifying, documenting, and reporting bugs found in their own software product.	Study Bug Life Cycle and reporting bugs for Your software product.	04	CO5
9	Install, configure, and use Selenium WebDriver to automate test cases for their software project (web-based), execute them, and validate expected results through automated scripts.	Test Software using Selenium WebDriver.	02	CO6

10	Use JUnit to write, execute, and validate unit test cases for their Java-based software project or selected modules, and interpret test results.	Test software using Junit	02	CO6

VI. Suggested Micro Project / Assignment/ Activities for Specific Learning / Skills Development (Self Learning):

1. Write a testing report on given software or application.
2. Design test cases for various software or application

VII. Specification Table:

Unit No	Topic Tit le	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Introduction to Software Testing	4	4	-	08
2	White box testing	4	4	4	12
3	Black Box Testing	4	4	4	12
4	Test Planning, Documentation and Bug Reporting:	2	2	4	8
5	Levels of Testing	2	4	4	10
6	Automated Tools	2	4	4	10
Total		**18**	**22**	**20**	**60**

VIII. Assessment Methodologies/Tools

Formative Assessment (Assessment for Learning)

- TH- Progressive /Periodic Test each of 20 Marks
- TL - Continuous Assessment of Tutorials for 25 Marks
- SL - Continuous Assessment of Self Learning for 25 Marks

Summative Assessment (Assessment of Learning)

- **TH -** Term End examination of 60 Marks

IX. Suggested COs - POs Matrix Form

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability y and Environment	PO-6 Project Management	PO-7 Life Long Learning g	PSO-1	PSO-2	PSO-3
CO1	3	-	-	-	-	-	2	1	1	1
CO2	3	2	2	-	-	2	2	1	3	1
CO3	3	2	2	-	-	2	2	2	2	2
CO4	2	2	2	-	-	2	2	2	2	3
CO5	2	2	2	-	-	2	1	2	3	3

X. Suggested Learning Materials / Books

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Software Testing	Ron Patton	978-1466560680
2	Software Testing: Principles, Techniques and Tools	M. G. Limaye	9780070139909
3	Software Testing: Principles and Practices	Naresh Chauhan	9780199465873

XI. Learning Websites & Portals

1. https://malenezi.github.io/malenezi/SE401/Books/Software-Testing-A-Craftsman-s-Approach-Fourth- Edition-Paul-C-Jorgensen.pdf
2. https://www.cigniti.com/resource/e-book/manual-testing-vs-automation-testing/

XII. Academic Consultation Committee/Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organization
1	Ms. Prajakta S. Sadafule	Lecturer in Computer Engineering	Govt. Polytechnic Mumbai
2	Dr. Rupali M. Komatwar	Lecturer in Computer Engineering	Govt. Polytechnic Mumbai
3	Mr. Samit Kumar Shukla	Project Manager	Cognizant Technology Services

Coordinator,
Curriculum Development,
Department of Computer Engineering

Head of Department
Department of Computer Engineering

I/C, Curriculum Development Cell
Government Polytechnic, Mumbai

Principal
Government Polytechnic, Mumbai

Programme: Diploma in Information Technology (Sandwich Pattern)													
Course Code: IT23402					**Course Title: Entrepreneurship and Start-ups**								
Compulsory / Optional: Compulsory													
Teaching Scheme and Credits						**Examination Scheme**							
CL	**TL**	**LL**	**SLH**	**NLH**	**Credits**	**FA-TH**		**SA-TH (2:30 Hrs.)**	**FA-PR**	**SA**		**SLA**	**Total**
										PR	**OR**		
1	-	2	1	4	2				25	25#	-	25	75

Total IKS Hrs. for course:

Abbreviations: CL- Class Room Learning, TL- Tutorial Learning, LL- Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, SLA- Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination, @$ Internal Online Examination

Note:

1. FA-TH represents an average of two class tests of 20 marks each conducted during the term.
2. SA-TH represents the end term examination.

I. Rationale

Entrepreneurs are often thought of as national assets to be refined, motivated and remunerated to the greatest possible extent. Entrepreneurs can change the way we live and work. If successful, their revolutions may improve our standard of living. In short, in addition to creating wealth from their entrepreneurial ventures, they also create jobs and the conditions for a flourishing society. This course will try to inculcate the values of Entrepreneurship and Start up among the students.

II. Industry / Employer Expected Outcome

Students should be able to understand concept Entrepreneurship and Start-ups.

III. Course Outcomes: Students will be able to achieve & demonstrate the following COs on completion of course based learning

CO1	Understand the dynamic role of entrepreneurship and small businesses.
CO2	Create business ideas / opportunities
CO3	Explain Financial Planning and Control
CO4	Illustrate Break Even Analysis
CO5	Choose Marketing Strategy
CO6	Explain New Product or Service development

V. Course Content Details:

Unit No.	Theory Learning Outcomes (TLO's)aligned to CO's	Topics / Sub-topics
1	**TLO 1.1:** Differentiate between Management and administration. **TLO 1.2** Define Human Resource Management **TLO 1.3:** Define Management, organization structure	**Introduction to Management** 1.1 Introduction to Management, organisation structure 1.2 Difference between Management & Administration 1.3 Concept of Scientific Management 1.4 Functions of management 1.5 Introduction to Human Resource Management Staffing, training & induction to staff. **Course Outcome: CO5** **Teaching Hours: 03 hrs** **Marks: NA**
2	**TLO 2.1:** Understand financial management **TLO 2.2**: Define Project management **TLO 2.3:** Understand CPM, PERT analysis & application Break even analysis, KAIZEN ,6S	**Financial & Project Management** 2.1 Importance of financial management 2.2 Financial organization and management 2.3 Budgets & their analysis 2.4 Project management 2.5 CPM, PERT analysis & application Break even analysis, KAIZEN ,6S. **Course Outcome: CO1, CO2** **Teaching Hours: 04 hrs** **Marks: NA**
3	**TLO 3.1:** Understand Types of Business Structures, differences between entrepreneur & manager **TLO 3.2:** State Business Ideas and their implementation **TLO 3.3:** Understand activity map and business plan.	**Introduction to Entrepreneurship** 3.1 Definitions, Traits of an entrepreneur, Entrepreneurship, Motivation 3.2 Types of Business Structures, differences between entrepreneur & manager 3.3 Business Ideas and their implementation 3.4 Discovering ideas and visualizing the business 3.5 Activity map 3.6 Business Plan Double Diamond Approach **Course Outcome: CO3, CO4** **Teaching Hours: 4 hrs** **Marks: NA**

4	**TLO 4.1:** Understand Idea to Start-up **TLO 4.2:** Identifying the target market **TLO 4.3: Understand** Marketing and accounting, Risk analysis	**Start ups** 4.1 Introduction, Idea to Start-up 4.2 Market Analysis – Identifying the target market, 4.3 Competition evaluation and Strategy Development, 4.4 Marketing and accounting, Risk analysis **Course Outcome: CO6** **Teaching Hours: 04 hrs** **Marks: NA**
5	**TLO 5.1:** Understand Financing and Protection of Ideas **TLO 5.2:** Know Financing methods available for start-ups in India **TLO 5.3:** Know Communication of Ideas to potential investors	**Planning for Startup** 5.1 Financing and Protection of Ideas 5.2 Financing methods available for start-ups in India 5.3 Communication of Ideas to potential investors – Investor Pitch, Patenting and Licenses
6	**TLO 6.1:** Understand Exit strategies for entrepreneurs, and succession and harvesting strategy	**Strategies for Entrepreneurs** 6.1 Exit strategies for entrepreneurs, bankruptcy, and succession and harvesting strategy

IV. Laboratory Learning Outcome and Aligned Practical / Tutorial Experiences.

NOTE: Total 6 experiments (or turns) out of 9 experiments (or turns)

Sr No	Practical / Tutorial / Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
1	**LLO: Able to understand what is** Entrepreneur	Interactive session with an Entrepreneur	2	CO1
2	**LLO**: Understand start-up	Brain storming of ideas for start-up in current scenario	4	CO1, CO2
3	**LLO**: Understand Identification of business opportunity	Identification of business opportunity	4	CO1, CO2
4	**LLO**: Understand the concept of Financing the start up	Financing the start up	2	CO1, CO2
5	**LLO**: Able to run the start up	Running the startup	4	CO1, CO2
6	**LLO**: Understand Break even analysis	Break even analysis	2	CO3, CO4
7	**LLO**: Understand Marketing strategy	Marketing strategy.	4	CO3, CO4

8	**LLO**: Able to Write, test and debug applications using menu	Write, test and debug applications using menu	4	CO3, CO4
9	**LLO**: Prepare project report.	Preparing project report	4	CO3, CO4
		Total	30	

V. Suggested Micro Project / Assignment/ Activities for Specific Learning / Skills Development (Self Learning):

1. Prepare journal of practical.
2. Prepare a presentation on the topic given by faculty.

VI. Assessment Methodologies/Tools

Formative assessment (Assessment for Learning)

- Rubrics for continuous assessment based on process and product related performance indicators (60 marks)

Summative Assessment (Assessment of Learning)

- End term examination, Viva-voce, Workshop performance (140 marks)

VII. COs - POs Matrix Form

Course Outcomes (COs)	**Programme Outcomes (POs)**							**Programme Specific Outcomes (PSOs)**		
	PO-1 Basic and Discipline Specific Knowledge	**PO-2 Problem Analysis**	**PO-3 Design/ Development of Solutions**	**PO-4 Engineering Tools**	**PO-5 Engineering Practices for Society, Sustainability and Environment**	**PO-6 Project Management**	**PO-7 Life Log Learning**	**PSO-1**	**PSO-2**	**PSO-3**
CO1	--	--	3	3	2	3	2	--	--	3
CO2	--	--	3	3	3	3	2	--	--	3
CO3	--	--	3	2	2	3	2	--	--	3
CO4	--	--	3	3	3	3	2	--	--	3
CO5	--	--	2	2	3	3	2	--	--	3
CO6	--	--	3	3	3	3	2	--	--	3

Legends: - High:03, Medium:02, Low:01, No Mapping: --

VIII. Suggested Learning Materials / Books

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company	Steve Blank and Bob Dorf, K & S Ranch Publication	978-0984999392
2	The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses	Eric Ries, Penguin UK	978-0670921607
3	Demand: Creating What People Love Before They Know They Want It	Adrian J. Slywotzky with Karl Weber, Headline Book Publishing	978-0755388974
4	The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business	Clayton M. Christensen, Harvard business	978-142219602

IX. Learning Websites & Portals

1. https://www.fundable.com/learn/resources/guides/startup
2. .https://corporatefinanceinstitute.com/resources/knowledge/finance/corporate- structure/
3. https://www.finder.com/small-business-finance-tips
4. https://www.profitbooks.net/funding-options-to-raise-startup-capital-for-your-business/

X. Academic Consultation Committee/Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organization
1	Ms. Namrata A. Wankhade	Lecturer Information Technology Department	Government Polytechnic, Mumbai
2	Ms. Dipali Gosavi	Lecturer Information Technology Department	Government Polytechnic, Mumbai
3	Miss. Rohini Yadav	Associate Developer	MUFG Mumbai

Coordinator,
Curriculum Development,
Department of Information Technology

Head of Department
Department of Information Technology

I/C, Curriculum Development Cell

Principal

Programme : Diploma in Computer Engineering													
Course Code: CO23402						**Course Title : Major Project**							
Compulsory / Optional: Compulsory													
Teaching Scheme and Credits						**Examination Scheme**							
CL	**TL**	**LL**	**SLH**	**NLH**	**Credits**	**FA-TH**		**SA-TH (**2Hrs.30 Min**)**	**FA-PR**	**SA**		**SLA**	**Total**
						T1	**T2**			**PR**	**OR**		
--	**---**	**04**	**04**	**08**	**04**	**--**	**--**	**--**	**50**	**--**	**50#**	**50**	**150**

Abbreviations: CL- ClassRoom Learning, TL- Tutorial Learning, LL- Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA - Summative assessment, SLA- Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination, @$ Internal Online Examination

Note:

1. FA-TH represents Total of two class tests of 20 marks each conducted during the term.
2. FA-PR represents Tutorial Term work of 25 Marks
3. SLA represents self learning Assessment of 25 Marks
4. SA-TH represents the end term examination of 60 Marks

I. Rationale:

In the field of Computer engineering various technologies (hardware and software) needs to be integrated and proper paradigm need to be implemented to develop any kind of computer applications. Hence it becomes essential to enhance skills in developing industrial applications. This course is essential to understand the implementation of the system development process i.e. design, analyze, coding, debugging and testing. This will help student to acquire skills and attitudes to work as a software developer.

II. Course Outcomes: Student should be able to

CO1	Works in groups, co-ordinate work, develop leadership qualities.
CO2	Identify the problem in any existing system.
CO3	Analyze the project requirements.
CO4	Choose relevant solution for the problem by using acquired practical knowledge.
CO5	Prepare project proposal including action plan.
CO6	Implement planned activity in a group/project implementation.
CO7	Prepare project report after performing due plagiarism check using appropriate tools.

III. Course Content Details:

Unit No	Topics / Sub-topics
1	**Area of Selection for the project** These are only guidelines. Any innovative ideas related to Computer engineering field may be included: 1. Advanced Mobile Applications. 2. AI and Robotics. 3. Internet of Things. 4. Networking 5. Animations. 6. Big data and data analytics. 7. Machine Learning. 8. Embedded Systems. 9. Designing software for IT applications. 10. Cyber security 11. Cloud Computing. 12. Interfacing of mobile devices with automated devices. 13. Image processing. **Course Outcome: CO1**
2	**Activity Plans: From Project Planning to actual Implementation** 1. Formation of groups. 2. Students are supposed to choose suitable domain/topic to work by doing Literature survey. Visit to industries/institutions/market fields (for sponsored projects). 3. Define problem statement for project work. 4. Submission of synopsis of the proposed work: by each group. (The project will be selected by approval of project guide. Synopsis document should be of 2-8 pages) 5. Progressive presentation of work. 6. Prepare a project proposal including action plan, methodology to carry out project work, So that it can be implemented smoothly. 7. Allocation of work responsibility to each group member. 8. Prepare system design including DFD, UML diagrams. 9. Actual implementation of planned work/project modules. 10. Testing of each module. 11. Assemble different modules together. 12. Progressive presentation of work. The activities should be monitored and guided by Project Guide every week during the contact hours provided for the same. The project diary should be maintained by student and get it checked by the Project Guide every week. **Course Outcome: CO1, CO2, CO3, CO4, CO5, CO6**

3	**Guidelines for writing Project report** Suggested contents of the Project report • Title page (with name of team members and mentor teacher) • Certificate (in the Format given in this document as annexure A) • Acknowledgements (this may need revision at the end of the final semester) • Abstract (in one paragraph not more than 150 words) • Content Page **Chapters** 1. Chapter-1 Introduction (background of the Industry or User based Problem/Task) 2. Chapter-2 Literature Survey (to finalise and define the Problem 3. Chapter-3 Scope of the project 4. Chapter-4 Methodology 5. Chapter-5 Details of designs, working and processes 6. Chapter-6 Results and Applications 7. Chapter-7 Conclusions And future scope 8. Appendix (if any) 9. References and Bibliography **Note:** i. The report should contain as many diagrams, figures and charts etc as relevant for the project. ii. Originality of the report (written in own words) would be given more importance rather than quality of printing and use of glossy paper or multi-colour printing **Format for report:** • Font type: Times New Roman • Font Size: headings- 14(bold), contents- 12 • Text Alignment: Justified • Line spacing: 1.5 • Header content: Name of the department at left side Title of the project at right side • Footer: Page number at center. **Course Outcome:CO5, CO7**

IV. Criteria of Marks for Formative Assessment for Major Project-Execution and Report Writing.

Sr. No.	Criteria	Marks
1	Project Proposal/Identification	10
2	Punctuality and overall contribution	10
3	Execution of Plan during sixth semester	10
4	Project Report including documentation	10
5	Presentation	10
	Total	50

V. Criteria of Marks for Summative Assessment of Major Project Execution and Report Writing

Evaluation shall be carried out according to following criteria. For each project, students from the concerned group should be asked to make presentation of their project, in front of the external and internal examiners which should be followed by question answer session to ascertain the contribution made by each student.

Sr. No.	Criteria	Marks
1	Project Proposal/Identification and overall contribution	10
2	Execution of Plan during sixth semester	10
3	Project Report including documentation	10
4	Presentation	10
5	Question and Answer	10
	Total	50

VI. Suggested Rubric for Major Project - Execution and Report Writing

S. No.	Characteristic to be assessed	Poor	Average	Good	Excellent
1	Problem/Task Identification (Project Title)	i. Relate to few POS ii. Scope of Problem not clear at all	i. Related to some POS ii. Scope of Problem/Task vague	i. Take care of at-least Three POS ii. Scope of Problem/task not very specific	Take care of more than three POS Scope of problem/task very clear
2	Literature Survey / Industrial Survey	Not more than ten sources (primary and secondary), very old reference	At-least 10 relevant sources, at least 5 latest	At least 15 relevant sources, most latest	clear About 20 relevant sources, most latest
3	Project proposal	Methods are not appropriate, All steps not mentioned, Design of prototype not started (if applicable)	Appropriate plan but not in much detail. Plan B for critical activities not mentioned. Time line is not developed Design of Prototype is not complete (if applicable)	Appropriate and detailed plan with Plan B for critical activities mentioned, but clarity is not there in methods, time line is given but not appropriate. Design of prototype is not detailed (if applicable)	Appropriate and detailed plan with Plan B for critical activities mentioned, clarity in methods with time line, Detailed design of prototype (if applicable)
4	Final Report Preparation	Very short, poor quality sketches, Details about methods, material, precaution and conclusions omitted, some details are wrong	Detailed, correct and clear description on methods, materials, precautions	Conclusions. Sufficient Graphic Description.	Very detailed, correct, clear description of methods, materials, precautions and conclusions, Enough tables,
5	Presentation	Major information	Includes major	Includes major	Well organized,

		is not included, information is not well organized	information but not well organized and not presented well	information and well organized but not presented well	includes major information, well presented
6	Defense	Could not reply to considerable number of question.	Replied to considerable number of questions but not very properly	Replied properly to considerable number of question.	Replied to most of the questions properly

VII. Suggested COs - POs Matrix Form

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Lifelong Learning	PSO- 1	PSO - 2	PSO - 3
CO1	1	2	1	1	2	1	3	2	2	-
CO2	3	3	2	2	3	2	3	2	3	3
CO3	3	2	3	3	2	3	3	2	3	3
CO4	3	3	3	3	3	3	3	2	3	3
CO5	3	3	3	3	3	3	3	2	3	3
CO6	3	3	3	3	3	3	3	2	3	3
CO7	3	3	3	3	3	3	3	2	3	3

Legends:- High:03, Medium:02,Low:01, No Mapping: -

*PSOs are to be formulated at institute level

VIII. Learning Resources:

Magazines:

Sr. No.	Title
1	IEEE Transactions Journals
2	Computer Today
3	PC Quest
4	Data Quest
5	Computer World
6	Any journal related to Computer/Information Technology/ Electronics field.

IX. Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr. Samit Kumar	Senior Project Associate	Cognizant Technology Solutions, Pune
2	Mrs. Megha Yawalkar	Lecturer in Computer Engineering	Govt. Polytechnic, Pune
3	Mrs. Vrushali Ashok Patil	Lecturer in Computer Engineering	Govt. Polytechnic, Thane
4	Dr. Rupali Komatwar	Lecturer in Computer Engineering	Govt. Polytechnic, Mumbai

Coordinator,
Curriculum Development,
Department of Computer Engineering

Head of Department
Department of Computer Engineering

I/C, Curriculum Development Cell
Govt. Polytechnic, Mumbai

Principal
Govt. Polytechnic Mumbai

Programme: Diploma in Computer Engineering (Sandwich Pattern)													
Course Code: CO23204						**Course Title: Cloud Computing**							
Compulsory / Optional: Optional													
Teaching Scheme and Credits						**Examination Scheme**							
CL	**TL**	**LL**	**SLH**	**NLH**	**Credits**	**FA-TH**		**SA-TH (**2Hrs.30 Min**)**	**FA- PR**	**SA**		**SLA**	**Total**
						T1	**T2**			**PR**	**OR**		
2	--	2	--	4	2	--	--	--	50	50#	--	--	100

Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL- Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, SLA- Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# Online Examination, @$ Internal Online Examination

I. Rationale

Cloud computing facilitates the access of applications and data from any location worldwide and from any device with an internet connection. It offers businesses with scalable computing resources hence saving them on the cost of acquiring and maintaining them. This course covers a series of current cloud computing technologies, including technologies for Infrastructure as a Service, Platform as a Service, Software as a Service, and Physical Systems as a Service. For different layers of the cloud technologies, practical solutions such as Google, Amazon, Microsoft, SalesForce.com, etc. solutions as well as theoretical solutions are introduced.

II. Course Outcomes: Students should be able to

CO1	Describe the basic concepts of Cloud Computing.
CO2	Use concept of Virtualization in Cloud Computing.
CO3	Analyze various cloud storage systems.
CO4	Demonstrate cloud Monitoring and Management techniques.
CO5	Study and Use concept of Cloud Security.
CO6	Compare different available Cloud Platforms.

III. Course Content Details:

Unit No.	Theory Learning Outcomes (TLO's)aligned to CO's.	Topics / Sub-topics
1	**TLO 1.1** Describe Cloud computing **TLO 1.2** Describe Cloud Deployment Model **TLO 1.3** Learn Cloud Service Models **TLO 1.4** Learn Cloud Economics, Benefits, Architecture and Infrastructure.	**Introduction to Cloud Computing** 1.1 From Client-Server and collaborative computing to Cloud computing, Defining cloud Computing, Characteristics of cloud computing. 1.2 Cloud Deployment Model: Public cloud, Private cloud, Community cloud, Hybrid cloud. 1.3 Cloud Service Models: IaaS, PaaS, SaaS. 1.4 Cloud Economics and Benefits 1.5 Architecture of Cloud computing 1.6 Cloud Computing Infrastructure
	Course Outcome: CO2	**Teaching Hours :5**
2	**TLO2.1**Learn Characteristics and types of Virtualizations **TLO 2.2** Describe Virtualization examples, advantages and disadvantages	**Virtualization** 2.1 Introduction, Characteristics of virtualized environment 2.2 Virtualization Types 2.3 Technology Example: Vmware, Microsoft Hyper-V, KVM , Xen server 2.4 Advantages of Virtualization, VM Migration, VM consolidation and VM Management 2.5 Disadvantages of virtualization
	Course Outcome: CO2	**Teaching Hours :5**
3	**TLO 3.1** Describe Storage system architecture. **TLO 3.2** Learn VDC . **TLO 3.3** Learn Block and file storage virtualization. **TLO 3.4** Understand VSAN and benefits. **TLO 3.5** Learn Cloud file systems	**Storage in Cloud** 3.1 Storage system architecture, 3.2 Virtual Data Centre (VDC) : Architecture, VDC Environment, server, storage, networking 3.3 Block and file level storage virtualization 3.4 Virtual Storage Area Network (VSAN) and benefits 3.5 Cloud file systems: Google File System (GFS) and Hadoop Distributed File System (HDFS) Comparison of GFS and HDFS.
	Course Outcome: CO3	**Teaching Hours :5**

4	**TLO 4.1** Understand Cloud Service Provider and users **TLO 4.2** Learn SLA types, Life Cycle Of SLA . **TLO 4.3** Learn cloud portal and its functions.	**Cloud Monitoring and Management** 4.1 Cloud Service Provider and users 4.2 SLA(Service Level Agreement) management: Types of SLA, Life cycle of SLA. 4.3 Service catlog, management and functional interfaces of services 4.4 Cloud portal and its functions 4.5 Cloud Service life cycle phases: Service planning, service creation, service operation and service termination,4.6 Software defined approach and techniques for managing IT resources
	Course Outcome: CO4	**Teaching Hours :5**
5	**TLO 5.1** Learn cloud security fundamentals and clod risks. **TLO 5.2 Apply** security Technologies on Cloud data. **TLO 5.3** Learn Digital identity and access management.	**Security in Cloud Computing** 5.1 Cloud Security Fundamentals 5.2 Cloud Risk 5.3 Cloud Risk division: Polity and Organizational Risks, Technical Risks and Legal risks 5.4 Technologies for Data security, Data security risk 5.5 Digital identity and access management 5.6 Content level security 5.7 Security-As-A-Cloud Service
	Course Outcome: CO5	**Teaching Hours :5**
6	**TLO 6.1** Learn Cloud trends, cloud platforms. **TLO 6.2** Understand Future of cloud and applications of cloud **TLO 6.3** Learn migration to cloud.	**Cloud Computing at Work** 6.1 Cloud trends in supporting Ubiquitous Computing 6.2 Cloud Platforms: Amazon EC2 and S3, Microsoft Azure, Cloud stack, Inter cloud, Google App Engine, Open stack, Open Nebula etc. 6.3 Future of Cloud-Based smart Devices, Faster time to Market for Software 6.4 Applications, Home Based Cloud Computing, Energy Aware Cloud Computing 6.5 Migrating to the Cloud: which application do you need? Sending your existing data to cloud, Cost Saving.
	Course Outcome: CO6	**Teaching Hours :5**

IV. Laboratory Learning Outcome and Aligned Practical / Tutorial Experiences.

Practical/Tutorial/Laboratory Learning Outcome (LLO)	**Sr No**	**Laboratory Experiment / Practical Titles / Tutorial**	**No. of hrs.**	**Relevant COs**
LLO1.1 Revise cloud concepts.	1	Review of cloud computing and its architecture.	02	CO1
LLO2.1 Learn Creation of Virtual Machines,	2	Creating Virtual Machines, installing Operating system and applications on Virtual Machine.	02	CO2
LLO3.1 Learn to delete and recreate VM.	3	Deleting Virtual Machine and recreating it.	02	CO2
LLO4.1 Learn to create VM image	4	Create a VM image and create VM from captured image.	02	CO2
LLO5.1 Learn the process of creating a Microsoft Azure Account (or any other free)	5	Create and document the process of creating a Microsoft Azure Account (or any other free)	02	CO3
LLO6.1 explore Microsoft Azure's management console	6	Create a free Microsoft Azure (or any other free) account and explore its management console	02	CO3
LLO7.1 Study current logy for Large Data ing	7	Study Current Technologies for Large Data Processing (Google-GFS, BigTable and MapReduce)	02	CO3
LLO8.1 Use Amazon EC2 or Google cloud for storage.	8	Demonstrate and use Amazon EC2 or Google cloud for storage.	02	CO4
LLO9.1 Install web server on VM and host simple web application on it.	9	Installing web server (Apache Tomcat) on VM, hosting simple web application on it.	02	CO4
LLO10.1 Implement the Virtualization using VM's Workstation.	10	Implementation of Virtualization using VM Ware 's Workstation or Oracle's Virtual Box and Guest O.S.	02	CO4
NA	11	Case Study of Security as a Service	02	CO5
NA	12	Case Study: PAAS(Facebook, Google App Engine)	02	CO6
NA	13	Case Study: Amazon Web Services.	02	CO6
LLO11.1 Learn Installation and Configuration of CloudSim.	14	Installation and Configuration of CloudSim.	02	CO6
LLO12.1 Learn to build application on cloud.	15	Building Application on Cloud	02	CO6

V. Assessment Methodology/Tools

Formative Assessment:

Formative assessment of 50 Marks

Summative Assessment (Assessment of Learning)

End term External Practical examination, Viva-voce, Workshop performance (50marks)

VI. CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	2	3	1	-	1	3	1	2	2
CO2	1	3	3	2	-	3	3	2	2	3
CO3	1	3	3	2	-	3	3	3	3	3
CO4	-	3	3	2	1	3	3	3	3	3
CO5	-	3	3	2	1	3	3	3	3	3

◆

VII. Suggested Learning Materials / Books

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Cloud Computing, Principals and Paradigms	Rajkumar Buyya, J.Broberg, A. Goscinski A John Wilwy & Sons, Inc.,	ISBN: 978-0-470-88799-8
2	Cloud Computing	Rishabh Sharma Wiley Publication	ISBN: 978-81- 265-5306-8
3	Handbook of Cloud Computing	Springer Publication	ISBN: 978-1- 4419-6524-0
4	Mastering Cloud Computing	Rajkumar Buyya. Christian Vecchiola, Tata McGraw Hill Publication	ISBN: 978-1-25-902995-0

VIII. Learning Websites & Portals E-References:

1.https://www.geeksforgeeks.org/cloud-computing/cloud-computing/
2.https://www.scribd.com/document/539915742/Cloud-Computing-Notes
3. https://www.tutorialspoint.com/cloud_computing/cloud_computing_tutorial.pdf

IX. Academic Consultation Committee/Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organization
1	Mrs. Vandana S. Lokhande	Lecturer in Computer Engg.	G.P. Mumbai
2	Mrs. Neha Vachani	Lecturer in Computer Engg.	G.P. Mumbai
3	Ms. Varshali Cholake-Landge	Senior Software Engineer	Volkswagen IT Services India Pvt. Ltd.

Coordinator,
Curriculum Development,
Department of Computer Engineering

Head of Department
Department of Computer Engineering

I/C, Curriculum Development Cell
Government Polytechnic, Mumbai

Principal
Government Polytechnic, Mumbai

Programme : Diploma in Computer Engineering													
Course Code:CO23205						**Course Title : Data Analytics using R**							
Compulsory / Optional: Optional													
Teaching Scheme and Credits						**Examination Scheme**							
CL	**TL**	**LL**	**SLH**	**NLH**	**Credits**	**FA-TH**		**SA-TH (**2Hrs.30 Min**)**	**FA-PR**	**SA**		**SLA**	**Total**
						T1	**T2**			**PR**	**OR**		
02	**---**	**02**	**--**	**04**	**02**	**--**	**--**	**--**	**50**	**50#**	**--**	**--**	**100**

Abbreviations: CL- ClassRoom Learning, TL- Tutorial Learning, LL- Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, SLA- Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination, @$ Internal Online Examination

Note:

1. FA-TH represents Total of two class tests of 20 marks each conducted during the term.
2. FA-PR represents Tutorial Term work of 25 Marks
3. SLA represents self learning Assessment of 25 Marks
4. SA-TH represents the end term examination of 60 Marks

I. Rationale

Data Analytics is the process of examining data sets in order to draw conclusions about the information they contain, with the aid of specialized system and software. This course introduces the most popular data analytics tool 'R'. The R language is widely used among statisticians and data miners for developing statistical software and for data analysis. 'R' is rapidly becoming a leading language in data science and statistics.

II. Industry / Employer Expected Outcome

Students will be able to

1. Analyse huge data and find solution.
2. Develop statistical software.

III. Course Outcomes: Students will be able to achieve & demonstrate the following COs on completion of course based learning.

CO1	Understand the Basic concepts of Data Science.
CO2	Perform different operations on R data structures.
CO3	Import/Export data from/to various files, database.
CO4	Perform Graphical analysis of imported data.
CO5	Build relationship model of data using Regression techniques.
CO6	Implement Object Oriented features of R.

IV. Course Content Details:

Unit No.	Theory Learning Outcomes (TLO's)aligned to CO's.	Topics / Sub-topics
1	**TLO 1.1** Understand notion of Data Science **TLO 1.2** Identify components and problem solving steps in data science **TLO 1.3** List tools used in Data Science	**Introduction to Data Science** 1.1 Data Science Basics 1.2 Introduction to Components of Data Science 1.2.1 Big Data 1.2.2 Data Mining 1.2.3 Data Analytics 1.2.4 Machine Learning 1.3 Problem Solving steps in Data Science 1.3.1 Collecting data 1.3.2 Data Preparation 1.3.3 Model Planning 1.3.4 Model Building 1.3.5 Driving insights and generating reports 1.3.6 Taking decision based on insights 1.4 Tools for Data Science(List out only) 1.4.1 Data Analysis tools 1.4.2 Data Warehousing 1.4.3 Data Visualization tools 1.4.4 Machine Learning tools 1.5 Job roles in Data Science Industry 1.6 Applications of Data Science **Course Outcome: CO1 Teaching Hours : 04**
2	**TLO 2.1** List features and basic data types in R **TLO 2.2** List Data Structures in R **TLO 2.3** Perform different operations on R data structures.	**R Programming Fundamentals** 2.1 Overview of R Language 2.2 Features of R 2.3 Basic Data Types and Operators in R 2.4 Data Structures in R • Vectors • Factors • Arrays • Matrices • Dataframes • List 2.5 Vectors 2.5.1 Properties of Vectors: type, length, attributes. 2.5.2 Working with Vectors

		• Creating and Deleting Vectors of different types using: seq( ), assign( ), Vector( ), rep( ), c( ), rm( ) functions • Sorting vector: sort( ) function • Dealing with NA (Not Available) values 2.5.3 Vector Indexing 2.5.4 Reading data using scan( ) function. 2.6 Factors 2.7 Arrays 2.7.1 Operations on Array and elements manipulation **Course Outcome: CO2 Teaching Hours : 08**
3	**TLO 3.1** List Data Structures in R **TLO 3.2** Perform different operations on R data structures. **TLO 3.3** Implement control structures in R.	**Data Structures in R(Contd.)** 3.1 Matrices 3.1.1 Operations on Matrix and element manipulation • Creating Matrices • Properties of Matrix: str( ), dim( ), length( ) functions • Naming rows and columns in Matrix: rownames( ), colnames( ) • Accessing and replacing Matrix elements using index • Adding rows and columns in Matrix: rbind( ), cbind( ) • Matrix Arithmetic 3.2 Dataframes 3.2.1 Operations on Dataframe and element manipulation • Creating Dataframe • Extracting data from Dataframe • Data Reshaping: Adding rows and columns, Merge Dataframes, Melting and Casting of Dataframe. • Sorting Dataframe: order( ) function • Data Sampling. • Deleting data 3.3 List 3.3.1 Operations on List and Components manipulation • Creating List and Accessing List components • Inserting and deleting components to/from List 3.4 Date and time functions in R 3.5 Strings in R • Working with String using different string functions.

		3.6 Control Structures in R 3.6.1 if-else 3.6.2 For loop 3.6.3 While loop 3.6.4 Repeat loop 3.6.5 Next, break 3.6.6 apply( ), sapply( ), lapply( ) functions **Course Outcome:CO2 Teaching Hours :08**
4	**TLO** 4.1 Import/Export data from/to various files, database **TLO** 4.2 Perform graphical analysis of imported data.	**Working with Data** 4.1 Functions in R 4.1.1 User Defined Function 4.1.2 Lazy evaluation of Function 4.2 Import and Export data to/from CSV file 4.3 Import and Export data to/from Excel file 4.4 Database connectivity via ODBC • Import data, perform different operation on it • Export data to database 4.5 Import XML file. • Convert XML file to Dataframe 4.6 Graphical data analysis 4.6.1 Simple Graph: plot( ) 4.6.2 Pie Chart 4.6.3 Bar Chart 4.6.4 Histogram 4.6.5 Boxplot **Course Outcome:CO3,CO4 Teaching Hours :06**
5	**TLO 5.1** Build relationship model of data using Regression techniques **TLO 5.2** Implement Object Oriented features of R	**Advanced R programming** 5.1 Mean, Mode, Median 5.2 Regression 5.2.1 Linear Regression 5.2.2 Multiple Regression 5.3 Object oriented programming in R 5.3.1 S3 and S4 classes. • Creating classes and objects. • Implementing object oriented feature like Inheritence. **Course Outcome: CO5, CO6 Teaching Hours :04**

IV. Laboratory Learning Outcome and Aligned Practical / Tutorial experiences.

Sr. No	Laboratory Learning Outcome	Laboratory Experiment / Practical Titles / Tutorial Titles	No. of hrs.	Relevant COs
1	**LLO 1.1** Install R studio and setting up R environment	1.1 Installation of R and R-Studio. 1.2 Setting up R environment	2	CO1
2	**LLO 2.1** Perform different operations on R data structures.	2.1 Create Vectors using different functions. 2.2 R as calculator: Perform various mathematical operations on Vectors Write R function to create 2 dimensional 4x3 Array of sequence of even integers greater than 40.	4	CO2
3	**LLO 3.1** Import/Export data from/to various files, database.	Develop R script to import/export data from/to: 3.1 CSV file and perform various operations on it. 3.2 EXCEL file and perform various operations on it.	2	CO3
4	**LLO 4.1** Perform Graphical analysis of imported data.	4.1 Draw simple graph using plot( ) function for a Vector. 4.2 Use different parameters of plot( ) to add elements in graph. character).	2	CO4
5	**LLO 5.1** Build relationship model of data using Regression techniques.	Write R script to build: 5.1 Linear regression model. 5.2 Multiple regression model.	2	CO5
6	**LLO 6.1** Implement Object Oriented features of R.	Develop R script to create S3 class, objects and functions.	2	CO6
7	**LLO 7.1** Perform different operations on R data structures.	Write R script to: 7.1 Find row and column index of maximum and minimum value in a given Matrix. Perform Inner, Outer, Left and Right join operations on two Dataframes.	2	CO2
8	**LLO 8.1** Import/Export data from/to various files, database.	Write R script to: 8.1 Generate multiplication table for user entered number. Create simple calculator using switch control structure.	4	CO3
9	**LLO 9.1** Perform Graphical analysis of imported data.	Draw pie chart, Bar Chart and Histogram for any of the built-in datasets.	2	CO4

10	**LLO 10.1** Implement Object Oriented features of R.	Develop R script create S4 class, objects and functions	2	CO6
11	**LLO 11.1** Perform different operations on R data structures.	Write R script to: 11.1 Find the length of first two components in List. To convert matrix into list.	2	CO2
12	**LLO 12.1** Import/Export data from/to various files, database.	Develop R script to connect to the database. Import data from database, manipulate it and export it to database.	4	CO3

V. MicroProject :

1. Route Optimization
2. Movie Rating Analysis
3. Social Media Sentiment Analysis
4. Financial Market Analysis

VI. Assessment

Methodologies/Tools

Formative assessment (Assessment for Learning)

- **LL** - Continuous Assessment of practicals for 50 Marks

Summative Assessment (Assessment of Learning)

- **PR -Term End Practical examination of 50 Marks**

VII. CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**1**	**3**
CO2	**3**	**2**	**1**	**1**	**1**	**1**	**2**	**3**	**2**	**2**
CO3	**3**	**3**	**2**	**3**	**1**	**1**	**2**	**3**	**2**	**3**
CO4	**3**	**3**	**3**	**3**	**1**	**1**	**2**	**3**	**2**	**3**
CO5	**3**	**3**	**3**	**3**	**1**	**1**	**2**	**3**	**2**	**3**
CO6	**2**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**

VIII. References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	R for beginners	Sandip Rakshit, McGraw Hill, 1st Edition-2017	9789352604555
2	R for Data Analysis	Mike McGrath	
3	R For Dummies	Andrie de Vries, Joris Meys, John Wiley & Sons, Inc. 2nd Edition-2015	978-1-119-05585-3 (epdf)

IX. Learning Websites & Portals

1. **http://adv-r.had.co.nz**
2. **www.studytrails.com**
3. **www.statisticsglobe.com**

X. Academic Consultation Committee/Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organization
1	Mr. Samit Kumar	Senior Project Associate	Cognizant Technology Solutions, Pune
2	Mrs. Megha Yawalkar	Lecturer in Computer Engineering	Govt. Polytechnic, Pune
3	Mrs. Vrushali Ashok Patil	Lecturer in Computer Engineering	Govt. Polytechnic, Thane
3	Mrs. N. H. Vachani (Curriculum Content Designer)	Lecturer in Computer Engineering	Government Polytechnic ,Mumbai

Coordinator,
Curriculum Development,
Department of Computer Engineering

Head of Department
Department of Computer Engineering

I/C, Curriculum Development Cell

Principal

Programme : Diploma in Computer Engineering													
Course Code: CO23206						**Course Title : Microcontroller and Embedded system**							
Compulsory / Optional: Optional													
Teaching Scheme and Credits						**Examination Scheme**							
CL	**TL**	**LL**	**SLH**	**NLH**	**Credits**	**FA-TH**		**SA-TH (2Hrs.30 Min)**	**FA-PR**	**SA**		**SLA**	**Total**
						T1	**T2**			**PR**	**OR**		
2	-	2	-	4	2	-	-	-	**50**	**50#**	**--**	**--**	**100**

Total IKS Hrs. for course:

Abbreviations: CL- Class Room Learning, TL- Tutorial Learning, LL- Laboratory Learning, SLH-Self Learning Hours, NLH- Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, SLA- Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination, @$ Internal Online Examination

Note:
1. FA-TH represents sum of two class tests of 40 marks each conducted during the term.
2. SA-TH represents the end term examination.

I. Rationale

Microcontroller is heart of all domestic, industrial, consumer goods and other high end products. Automation in every field of life is being used and microcontroller is inbuilt element of these systems and devices. 8051 microcontroller architecture, peripheral interfacing to it and assembly language programming is covered in this course. Microcontroller is inbuilt element of embedded system. This course will also cover the concepts of embedded system. It covers Arduino and its programming.

II. Industry / Employer Expected Outcome

Students should have

1. Proficiency in Microcontroller Programming and Application Development
2. Expertise in Peripheral Interfacing and Control
3. Competence in Timer, Interrupt, and Communication Protocols
4. Foundation in Embedded Systems Design and Open Source Development

III. Course Outcomes: Students will be able to achieve & demonstrate the following COs on completion of course based learning

CO1	Comprehend the architecture and signal description of 8051.
CO2	Develop the program for 8051 for the given operations.
CO3	Interpret the program by using timer, interrupt and serial port/parallel port.
CO4	Interface various input and output devices to microcontroller.
CO5	Comprehend the concept of embedded systems, aurdino and its programming.

IV. Course Content Details:

Unit No.	Theory Learning Outcomes (TLO's)aligned to CO's	Topics / Sub-topics
1	**TLO 1.1:** Explain the General architecture of Microcontroller. **TLO 1.2 :** Compare between Microprocessor and Microcontroller **TLO 1.3:** Describe the Architecture of 8051 **TLO 1.4:** Explain the Pin configuration aand function of each pin of 8051. **TLO 1.5**: Interpret the Memory Organization of 8051 **TLO 1.6**: Identify the Special features of 8051	**Basics of Microcontroller 8051** 1.1 General architecture of Microcontroller 1.2 Comparison of Microprocessor and Microcontroller 1.3 Architecture of 8051 1.4 Pin configuration and signal description of 8051 1.5 Memory Organization of 8051 1.6 Special features of 8051- Boolean Processor, Power saving options- idle and power down mode, Derivatives of 8051(8951, 8952, 8031, 8751). **Course Outcome- CO1 Teaching Hours – 06**
2	**TLO 2.1**: Interpret the Instruction set of 8051. **TLO 2.2:** Explain the Addressing Modes of 8051 **TLO 2.3:** Write Assembly language programs for given problem statement **TLO 2.4:**: Write C language program for given problem statement	**8051 Instruction set and Programming** 2.1 Instruction set (Data transfer, Arithmetic and Logical, Branching, Machine control, stack operation, Boolean) 2.2 Addressing modes 2.3 Assembly language programming 2.4 8051 programming in C **Course Outcome- CO2 Teaching Hours – 06**
3	**TLO 3.1:** Explain the Timer/Counter operation and programming of 8051. **TLO 3.**2: Describe the Interrupt structure of 8051. **TLO 3.**3: Explain Serial Communication operation and programming of 8051. **TLO 3.**4: Explain Parallel communication I/O port structure and its programming	**Timer, Interrupts, Serial and Parallel communication** 3.1 8051 Timer/Counter: Logic and Modes, Programming of 8051 timer 3.2 8051 Interrupts: Interrupts and polling, SFRs- IE, IP, Priority level and interrupt sequence 3.3 Serial Communication: SCON, SBUF, Modes of serial communication, Programs on serial communication 3.4 Parallel communication: I/O port structure and its programming **Course Outcome- CO3 Teaching Hours – 06**

4	**TLO 4.1:** Understand the Memory Interfacing. **TLO 4.**2 : Explain I/O Interfacing of 8051. **TLO 4.**3 : Explain various applications of 8051	**Memory and I/O Interfacing** 4.1 Memory Interfacing: Interfacing of external program and data memory, Address map table 4.2 I/O Interfacing: Interfacing of LEDs, Relays, Keyboard, Seven segment display, LCD, Stepper motor, DC motor, ADC 0808, DAC 0808 4.3 Applications of 8051: Square wave generation using port pins of 8051, Triangular wave generation using DAC, Water level controller, Temperature controller using ADC, Stepper motor control for clockwise and anticlockwise rotation, Traffic light controller Programming can be in assembly language or C (student's choice) **Course Outcome- CO 4 Teaching Hours: 04**
5	**TLO 5.1:** Block diagram of embedded system with hardware components. **TLO 5.1:** Harvard and Von Neumann architecture, RISC and CISC processors **TLO 5.1:** Characteristics of embedded system, Processor power, memory, operating system, reliability, performance, power consumption, unit cost size, flexibility, **TLO 5.1:** Classification of embedded system	**Introduction to embedded systems** 5.1 Block diagram of embedded system with hardware components. 5.2 Harvard and Von Neumann architecture, RISC and CISC processors 5.3 Characteristics of embedded system, Processor power, memory, operating system, reliability, performance, power consumption, unit cost size, flexibility, 5.4 Classification of embedded system **Course Outcome: CO5 Teaching Hours :4hrs**
6	**TLO 6.1:** Understand Arduino Birth and Open source community **TLO 6.2:** Explain the functional block diagram of Arduino **TLO 6.3**: Interpret the functions of each pin of Arduino **TLO 6.4:** Explain the I/O functions, looping techniques, Decision making techniques. **TLO 6.5:** Understand the Programming of an Arduino.	**Open source embedded development board (Arduino)** 6.1 Arduino Birth, Open source community 6.2 Functional block diagram of Arduino 6.3 Functions of each pin of Arduino 6.4 I/O functions, looping techniques, Decision making techniques. 6.5 Programming of an Arduino: Interfacing LEDs, Seven segment display, LCD, ADC, DAC, Stepper motor, DC Motor. Various applications using Arduino. **Course Outcome: CO5 Teaching Hours :4hrs**

V. Laboratory Learning Outcome and Aligned Practical / Tutorial Experiences.

Sr No	Practical / Tutorial / Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant Cos
1	Demonstrate the ability to identify and describe the functions of various blocks and components on the 8051 microcontroller development board.	Identify various blocks of 8051 microcontroller development board	02	CO1
2	Develop and debug assembly language programs to perform basic arithmetic operations, demonstrating understanding of instruction sets and registers.	Write an assembly language program to perform arithmetic operations such as addition, subtraction, multiplication and division	02	CO2
3	Implement and test an assembly language program to identify the smallest and largest numbers from a set of data bytes	Write an ALP to find smallest /largest numbers from the given data bytes stored in internal /external data memory locations.	02	CO2
4	Write, debug, and execute an assembly language program to sort a list of numbers in ascending or descending order	Write an ALP to arrange numbers in ascending/descending order.	02	CO2
5	Interface an LED with a microcontroller and write a program in C or assembly language to control the LED	Interface LED with microcontroller and turn it ON for 1 sec. Write program either in C or assembly language.	02	CO3 CO4
6	Create and test an assembly language program to generate pulse and square wave signals using timer delays	Develop an ALP to generate pulse and square wave by using timer delay.	02	CO3
7	Interface a 7-segment display with the 8051 microcontroller and write a program to display numbers 0 to 9	Interface 7 segment display to 8051 and display numbers 0 to 9 on it.	02	CO4
8	Interface a 4x4 keyboard matrix with the 8051 microcontroller and write a program to detect key presses and display them on a 7- segment display	Interface 4X4 keyboard matrix with 8051 and display the key pressed on 7 segment display	02	CO4
9	Interface a stepper motor with the 8051 microcontroller and develop a program to control its rotation in both directions for specified angles	Interface stepper motor to 8051 and write a program to rotate in clockwise and anticlockwise direction for given angles	02	CO4
10	Write and implement a program to control the speed of a DC motor using Arduino	Write a Program to Control the speed of DC motor using Arduino.	02	CO5
11	Design and implement a line follower robot using Arduino	Implement line follower robot using Arduino.	02	CO5
12	Develop and test a water level controller using Arduino	Implement water level controller using Arduino	02	CO5
13	Implement a digital thermometer using Arduino,	Implement Digital Thermometer using Arduino	04	CO5
14	Interface a 4x4 keyboard matrix and a 16x2 LCD to Arduino and develop a program to display the key presses on the LCD	Interface 4x4 keyboard matrix and 16x2 LCD to Arduino	04	CO5

VI. Suggested Micro Project / Assignment/ Activities for Specific Learning / Skills Development (Self Learning):

1. Create a detailed presentation or a report that compares the 8051 with other microcontrollers like 8951, 8952, 8031, and 8751.
2. Create a project where an LED blinks with a specific pattern controlled by timers and interrupts.
3. Develop a report or presentation highlighting the characteristics and classifications of embedded systems, and provide real-world examples.
4. Develop a series of projects using Arduino, such as:
    - Blinking LEDs with different patterns.
    - Displaying information on an LCD.
    - Reading analog values from a sensor and displaying them.
    - Controlling a DC motor with a PWM signal.
    - Creating a simple weather station that reads temperature and humidity.
5. Select an embedded system (e.g., a smart thermostat, a wearable fitness tracker) and analyze its hardware components, architecture, and performance characteristics. Prepare a detailed case study.

VII. Assessment Methodologies/Tools

Formative assessment (Assessment for Learning)

- Rubrics for continuous assessment based on process and product related performance indicators (65 marks)

Summative Assessment (Assessment of Learning)

- End term examination, Viva-voce, Workshop performance (85 marks)

VIII. COs - POs Matrix Form

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	**PO-2 Problem Analysis**	**PO-3 Design/ Development of Solutions**	**PO-4 Engineering Tools**	**PO-5 Engineering Practices for Society, Sustainability and Environment**	**PO-6 Project Management**	**PO-7 Life Long Learning**	**PSO-1**	**PSO-2**	**PSO - 3**
CO1	3	-	-		2	1	-	2		1
CO2	1	3	2	2	-	-	1		2	-
CO3	-	2	-	-	3	1	2	2	-	-
CO4	2	-	2	--	-	2	-	3	-	-
CO5	2	-	-	2	2	-	1	-	2	-
Legends: - High:03, Medium:02, Low:01, No Mapping: --										

IX. Suggested Learning Materials / Books

Sr. No	Author/ Publisher	Title	ISBN
1	The 8051 Microcontroller and Embedded Systems: Using Assembly and C	Mazidi, Pearson Education India; 2 edition 2007	978-8131710265
2	The 8051 Microcontroller & Embedded Systems Using Assembly and C with CD	Kenneth Ayala, Delmar Cengage Learning; First edition, January 2010	978-8131511053
3	Introduction to Embedded System	Shibu K. V., MC Graw Hill, First edition, 2009	978-1259081514
4	Beginning Arduino	Michael McRoberts, Technology in action, First edition 2010	978-1430232414
5	Programming Arduino Getting started with sketches	Simon monk, MC Graw Hill, First edition, 2012	978-0071784238

X. Learning Websites & Portals

Sr.No	Link / Portal
1	https://www.coursera.org
2	https://www.edx.org/
3	https://www.udemy.com/
4	https://ocw.mit.edu/
5	https://www.allaboutcircuits.com/
6	https://www.hackster.io/
7	https://swayam.gov.in/

XI. Academic Consultation Committee/Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organization
1	Mr. Girish V. Sonone	Lecturer in Electronics Engineering	Government Polytechnic, Mumbai
2	Mr. Anjum Mujawar	Director	Discover Technologies Thane
3	Dr. N D Chavan	Lecturer in Electronics Engineering	L J Somaiya Polytechnic, Mumbai

Coordinator,
Curriculum Development,
Department of Computer Engineering

Head of Department
Department of Computer Engineering

I/C, Curriculum Development Cell

Principal