C

Government Polytechnic Mumbai

(Academically Autonomous Institute of Govt. of Maharashtra)

Department of Information Technology

P-23 Curriculum

(Sandwich Pattern + Out Come Based)

SEMESTER 5

Government Polytechnic Mumbai

(Academically Autonomous Institute, Government of Maharashtra)

Programme Name	Diploma In Information Technology	Year	2023-24
Programme Code	IF	Duration	16 WEEKS
Duration Of Programme	6 Semester	Scheme	P23
Semester	Fifth		

SR.NO	Course Title	Course Type	course code	Learning Scheme: Total IKS Hrs.for sem	Atual contact Hrs./Week: CL	TL	LL	self learning (TW+ ASSIGNMENT)	Notional learning /week	credits	paper Duration	Examination Scheme(Marks): Theory FA-TH T1 MAX	FA-TH T2 MAX	SA-TH MAX	Total MAX	Total MIN	BASED ON LL&TL PRACTICAL FA-PR MAX	FA-PR MIN	SA-PR OR MAX	SA-PR OR MIN	SA-PR PR MAX	SA-PR PR MIN	Basedon Self learning SLA MAX	SLA MIN	TOTAL MARKS
								Total				MAX	MAX	MAX	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	
1	Cloud Computing	DSC	IT23110		3		4	1	8	4	3	20	20	60	100	40	25	10	25#	10	_	_	25	10	175
2	Mobile Application Development	SEC	CO23604		2		4		6	3							50	20	_		50#	20			100
3	Geographical Information System/ Software Testing and Quality Assurance/ Internet of things	DSE	IT23203/ IT23204/ IT23205		3		4	1	8	4	3	20	20	60	100	40	25	10	25#	10	_	_	25	10	175
4	Network And Information Security	DSC	IT23111		3		2	1	6	3	3	20	20	60	100	40	25	10	25#	10	_	_	25	10	175
5	Project	INP	IT23403				4	4	8	4							50	20	100#	40			50	20	200
6	R Programming (Mooc)	SEC	IT23606					4	4	2															
	Total			0	11	0	18	11	40	20															825

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CDC Co-ordinator
G. P. Mumbai

Abbreviations: CL-Classroom Learning ,TL-Tutorial Learning,LL-LaboratoryLearning,FA-FormativeAssessment,SA-SummativeAssessment,IKS-IndianKnowledgeSystem,SLA-SelfLearningAssessment Legends : @ Internal Assessment, # External Assessment

Note:1.FA-THrepresentstwoclasstestsof20markseachconductedduringthe 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 the candidate shall be declared as fail and will have to repeat and resubmit SLA work.

4. Notional Learning hours for the semester rare (CL+LL+TL+SL)hrs.*15Weeks

5.1creditis equivalent to 30 Notional hrs.

6.*Self learning hours shall not be reflected in the Time Table.

Course Category: Discipline Specific Course Core(DSC):2,Discipline Specific Elective(DSE):0,Value Education Course(VEC):1,Intern./Apprenti./Project./Community(INP):0,

Ability Enhancement Course (AEC):2,Skill Enhancement Course(SEC):2,GenericElective(GE):0

Coordinator
Curriculum Development

In-Charge
Curriculum Development Cell
I.T.

Head of Department
Department of Information Technology

Principal

Programme: Diploma in Information Technology (Sandwich Pattern)												
Course Code: IT23110					Course Title: Cloud Computing							
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		
3	-	4	1	8	4	20	20	60	25	-	25#	25	175

Total IKS Hrs. for course:

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

I. Rationale

Cloud computing has evolved as a very important computing model, which enables information, software, and other shared resources to be provisioned over the network as services in an on-demand manner. There are many aspects of cloud computing viz cloud types, storage in cloud, security in cloud, cloud monitoring and management. Having specific skills in these areas is necessary for diploma pass-outs to create and maintain cloud based services. After learning this course student will be able to implement virtualization, create cloud based storage, Implement security, and manage cloud services.

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

CO1	Maintain Cloud Based Application.
CO2	Implement virtualization in Cloud Computing.
CO3	Maintain Storage System in Cloud.
CO4	Maintain Cloud Services.
CO5	Implement Security in Cloud Computing.
CO6	Implement cloud on different platforms.

Course Content Details:

Unit No.	Theory Learning Outcomes (TLO's)aligned to CO's	Topics / Sub-topics
1	**TLO 1.1** Explain the specified characteristics of Cloud Computing. **TLO 1.2**: Compare the given Cloud Deployment Models on the given criteria. **TLO 1.3:** Explain the given service offered by identified Cloud Service Model. **TLO 1.4:** Explain the given component of cloud computing architecture **TLO 1.5:** Write steps to use Cloud Based Integrated Development Environment to develop the given application.	**1. Fundamentals of Cloud Computing** 1.1 Cloud Computing, Essential 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 1.7 Cloud-Based Integrated Development Environment (IDE) to write, run, and debug code with a browser. **Course Outcome: CO1** **Teaching Hours: 04 hrs** **Marks: 06**
2	**TLO 2.1:** Explain the given feature of Virtualization. **TLO 2.2**: Explain the characteristics of the specified Virtualization type **TLO 2.3:** Write generic steps to build a virtual machine using VMWare on the given OS. **TLO 2.4**: Describe the given disadvantage of Virtualization.	**2.Virtualization** 2.1 Introduction, Virtualization Reference Model, Characteristics of virtualized environment 2.2 Virtualization Types 2.3 Technology Example: VMWare, Microsoft Hyper-V, KVM, Xen 2.4 Advantages: Virtual Machine(VM), VM Migration, VM Consolidation, VM Management 2.5 Disadvantages of Virtualization **Course Outcome: CO2** **Teaching Hours: 08hrs** **Marks: 9**

3	**TLO 3.1:** Explain the given component of storage system architecture. **TLO 3.2:** Write steps to design storage system for the given cloud set-up. **TLO 3.3:** Compare GFS and HDFS based on the given criteria.	**3.Storage In Cloud** 3.1 Storage System Architecture, 3.2 Virtualize Data Centre (VDC) Architecture, VDC Environment, server, storage, networking, desktop and application virtualization techniques and benefits. 3.3 Block and file level storage virtualization, Virtual Provisioning, and automated storage tiering, Virtual storage area network(VSAN) and benefits, 3.4 Cloud file systems: Google File System GFS and Hadoop Distributed File System HDFS, **Course Outcome: CO3** **Teaching Hours:10hrs** **Marks: 16**
4	**TLO 4.1:** Describe the given component of federated cloud computing. **TLO 4.2:** Compare different types of SLA based on the given criteria. **TLO 4.3:** Describe the given cloud interface standard. **TLO 4.4** :Explain the steps to use relevant technique for managing the given Cloud resource.	**4.Cloud Monitoring and Management** 4.1 Service Provider and users 4.2 An architecture of federated cloud computing 4.3 Service Level Agreement (SLA) management: Types of SLA, Life cycle of SLA. 4.4 Service catalog, management and functional interfaces of services, 4.5 Cloud portal and its functions 4.6 Cloud Service life cycle phases: Service planning, service creation, service operation and service termination 4.7 Cloud resource management •Ab-initio Resource Assignment •Periodic Resource Optimization **Course Outcome: CO4** **Teaching Hours:08hrs** **Marks: 11**

5	**TLO 5.1:** Explain the given security related risk in Cloud Computing. **TLO 5.2:** Explain the specified feature of Key security terminology for data security. **TLO 5.3**: Write steps to implement the given Technology for Securing the Data on cloud.. **TLO 5.4:** Write steps to manage the Identity and Access facility of given Cloud set-up. **TLO 5.5 :** Explain the given feature of Security-As-A-Cloud Service.	**5 Security In Cloud Computing** 5.1 Cloud Security Fundamentals 5.2 Cloud Risk, Cloud Risk division • Polity and Organizational Risks • Technical Risks • Legal risks 5.3 Technologies for Data security, Data security risk 5.4 Digital identity and access management, 5.5 Content level security 5.6 Security-As-A-Cloud Service **Course Outcome: CO5** **Teaching Hours: 06hrs** **Marks: 10**
6	**TLO 6.1:** Explain the characteristics of the given Enabling Technology with the IoT. **TLO 6.2:** Select relevant cloud platform for the identified application with justification. **TLO 6.3**: Describe the features of the given type of cloud-based smart device. **TLO 6.4:** Compare features of the given cloud platforms on the specified criteria.	**6.Trends and Future in Cloud Computing** 6.1 Cloud trends in supporting Ubiquitous Computing 6.2 Enabling Technologies with the Internet of Things (RFID, Sensor Networks and ZigBee Technologies, GPS) 6.3 Innovative Applications with the Internet of Things (Ex: Smart Buildings and Smart Power Grid) 6.4 Future of Cloud-Based smart Devices, Home Based Cloud Computing, Energy Aware Cloud Computing. 6.5 Cloud Platforms: Amazon EC2 and S3, Microsoft Azure, Cloudstack, Intercloud, Google App Engine, Open Source cloud Eucalyptus, Open stack, Open Nebulla, etc., **Course Outcome: CO6** **Teaching Hours: 09hrs** **Marks: 08**

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

NOTE: Total 10 experiments (or turns) out of 18 experiments (or turns)

Sr No	Practical / Tutorial / LaboratoryLearning Outcome (LLO)	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
1	**LLO**: Understand basic cloud .	Use Goggle Doc to make spreadsheet and notes	2	CO1
2	**LLO**: Explore the JustCloud	Install/Configure cloud using JustCloud	2	CO2
3	**LLO**: Understand cloud9 services	Use Cloud9 to demonstrate use of different language	2	CO3
4	**LLO** :Understand VMware as private cloud.	Create/Delete Virtual Machines using VMware (Private Cloud)	2	CO2
5	**LLO**: Understand storage service of cloud	Implement Storage Service on Cloud using OpenStack-	2	CO3
6	**LLO**: Understand use of OpenStack	Use OpenStack for File Management	2	CO4
7	**LLO**:. Understand Nagios Tool	Monitor cloud using Nagios Tool	2	CO4
8	**LLO**: Understand use of different cloud platform	Create and Host Simple Web Application on Microsoft Azure/Google cloud/Any cloud platform(Part-I)	2	CO5
9	**LLO**: Understand use of different cloud platform	Create and Host Simple Web Application on Microsoft Azure/Google cloud/Any cloud platform (Part-II)	2	CO5
10	**LLO**: understand work of Codenvy.	Work in Codenvy to show Provisioning and Scaling of a website (Part-1)	2	CO5
11	**LLO**: understand work of Codenvy.	Work in Codenvy to show Provisioning and Scaling of a website (Part-II)	2	CO5
12	**LLO**:Understand management of OpenStack	Implement Identity Management and Access Management using OpenStack	2	CO3
13	**LLO**:Understand working Azureto cloud	Configure Servers using Microsoft Azureto secure it. (Part-1)	2	CO4
14	**LLO**: Understand Azureto cloud	Configure Servers using Microsoft Azureto secure it. (Part-II)	2	CO4
15	**LLO**: Understand working of IoT and Arduino/Rasberry PI	Design a small application based on IoT using Arduino or Raspberry pi (Part-1)	2	CO6
16	**LLO**: Understand working of IoT and Arduino/ Rasberry PI	Design a small application based on IoT using Arduino or Raspberry pi (Part-II)	2	CO6
		Total	32	

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

1. Prepare journal of practical.
2. Undertake mini project. Develop a Java application for the requirement given by faculty.
3. Prepare a presentation on the topic given by faculty.

V. Specification Table:

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Fundamentals of Cloud Computing	2	4		6
2	Virtualization	2	3	4	9
3	Storage In Cloud	4	6	6	16
4	Cloud Monitoring and Management	2	3	6	11
5	Security In Cloud Computing		4	6	10
6	Trends and Future in Cloud Computing	4	4		8
Total		14	24	22	60

VI.AssessmentMethodologies/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 (175)

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	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
CO6	3	3	3	1	-	1	3	1	2	2

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

VIII. Suggested Learning Materials / Books

Sr.No	Author/ Publisher	Title	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	Mastering Cloud Computing	Rajkumar Buyya. Christian Vecchiola, Tata McGraw Hill Publication	ISBN: 978-1-25- 902995-0

IX. Learning Websites & Portals

Sr.No	Link / Portal
1	https://www.geeksforgeeks.org/cloud-computing-tutorial/
2	https://azure.microsoft.com/en-in/resources/cloud-computing-dictionary/what-is-cloud-computing/
3	https://onlinecourses.nptel.ac.in/
4	https://www.technopedio.com

X. Academic Consultation Committee/Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organization
1	Ms.Dipali Bhaskar Gosavi	Lecturer Information Technology	Government Polytechnic Mumbai
2	Pradnya Bhikaji Natekar	lecturer	Shri Bhagubhai Mafatlal polytechnic and college of engineering ville Parle west
3	Mr.Rohan Gopale	Software Quality Assurance	India First Life

Coordinator,
Curriculum Development,
Department of Information Technology

Head of Department
Department of Information Technology

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CDC Co-ordinator
G. P. Mumbai

I/C, Curriculum Development Cell

Principal

Programme: Diploma in Information Technology (Sandwich Pattern)													
Course Code: IT23203						Course Title: Geographical Information System(GIS)							
Compulsory / Optional: Compulsory													
Teaching Scheme and Credits						Examination Scheme							
										SA			
CL	TL	LL	SLH	NLH	Credits	FA-TH		SA-TH (2:30 Hrs.)	FA-PR	PR	OR	SLA	Total
3	-	2	1	6	3	20	20	60	25		25#	25	175

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

GIS (Geographic Information Systems) is a computer-based tool that uses spatial (geographic) data to analyze and solve real-world problems. This course is designed to introduce the student to the basic principles and techniques of GIS. Introduction to GIS is designed to provide the students withan understanding of the methods and theories of spatial analysis that will allow students to apply GIS knowledge and skills to everyday life and their chosen careers.

II. Course Outcomes:

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

CO1	Define GIS and Spatial data
CO2	Compare Spatial Referencing and Positioning
CO3	Identify vector and raster data structures and the appropriate use of each of these data structures
CO4	Learn the basics of data capture, storage, analysis, and output in a GIS
CO5	Explain data visualization
CO6	Organize and process different data

Course Content Details:

Unit No.	Theory Learning Outcomes (TLO's)aligned to CO's	Topics / Sub-topics
1	**TLO 1.1:** Understand GIS Concepts and applications **TLO 1.2**: Learn to represent the real world using GIS models **TLO 1.3.1:** Understand geographic phenomena and fields **TLO 1.3.2:** Learn digital representation of geographic data. **TLO 1.4:** Understand spatial data organization and management. **TLO 1.5:** Learn how GIS handles time-based data.	**Introduction to GIS** **1.1 The nature of GIS:** Some fundamental observations, Defining GIS, GISystems, GIScience and GIApplications, Spatial data and Geoinformation. **1.2 The real world and representations of it:** Models and modelling, Maps, Databases, Spatial databases and spatial analysis **1.3 Models and Representations of the real world:** **1.3.1 Geographic Phenomena:** Defining geographic phenomena, types of geographic phenomena, Geographic fields, Geographic objects, Boundaries **1.3.2 Computer Representations of Geographic Information:** Regular tessellations, irregular tessellations, Vector representations, Topology and Spatial relationships, Scale and Resolution, Representation of Geographic fields, Representation of Geographic objects **1.4 Organizing and Managing Spatial Data** **1.5 The Temporal Dimension** **Course Outcome:CO1** **Teaching Hours :06** **Marks: 08 (R- 02 , U- 02 , A- 04)**
2	**TLO 2.1:** Know trends in GIS hardware and software. **TLO 2.2**: Understand GIS software and architecture. **TLO 2.3:** Learn steps in spatial data handling and analysis. **TLO 2.4:** Understand DBMS use in GIS. **TLO 2.5:** Learn integration of GIS with spatial databases.	**Data Management and Processing System** **2.1 Hardware and Software Trends** **2.2 Geographic Information Systems:** GIS Software, GIS Architecture and functionality, Spatial Data Infrastructure (SDI) **2.3 Stages of Spatial Data handling:** Spatial data handling and preparation, Spatial Data Storage and maintenance, Spatial Query and Analysis, Spatial Data Presentation. **2.4 Database management Systems:** Reasons for using a DBMS, Alternatives for datamanagement, The relational data model, Querying the relational database. **2.5 GIS and Spatial Databases:** Linking GIS and

		DBMS, Spatial database functionality. **Course Outcome:CO4, C03** **Teaching Hours :05** **Marks: 10 (R- 04 , U- 02 , A- 04)**
3	**TLO 3.1:** Understand Spatial Referencing **TLO 3.2:** Understand Spatial Positioning	**Spatial Referencing and Positioning** **3.1 Spatial Referencing:** Reference surfaces for mapping, Coordinate Systems, MapProjections, Coordinate Transformations **3.2 Satellite-based Positioning:** Absolute positioning, Errors in absolute positioning, Relative positioning, Network positioning, code versus phase measurements, Positioning technology **Course Outcome: CO2** **Teaching Hours : 07** **Marks: 10(R- 02 , U- 02 , A- 06)**
4	**TLO 4.1**: Learn spatial data input techniques. **TLO 4.2:** Understand spatial data quality checks. **TLO 4.3:** Prepare and clean spatial datasets. **TLO 4.4**: Learn to transform and interpolate point data.	**Data Entry and Preparation** **4.1 Spatial Data Input:** Direct spatial data capture, Indirect spatial data capture, Obtaining spatial data elsewhere **4.2 Data Quality:** Accuracy and Positioning, Positional accuracy, Attribute accuracy,temporal accuracy, Lineage, Completeness, Logical consistency **4.3 Data Preparation:** Data checks and repairs, Combining data from multiple sources **4.4 PointData Transformation:** Interpolating discrete data, Interpolating continuous data **Course Outcome:CO4** **Teaching Hours : 07** **Marks: 10 (R- 02 , U- 04 , A- 04)**

5	**TLO 5.1:** Understand types of analytical GIS capabilities **TLO 5.2**: Learn to retrieve, classify, and measure spatial data. **TLO 5.3**: Apply vector and raster overlay functions. **TLO 5.4**: Use neighborhood functions for spatial analysis. **TLO 5.5**: Understand network analysis and terrain modeling. **TLO 5.6**: Learn application models and GIS standards. **TLO 5.7**: Understand error propagation in spatial data.	**Spatial Data Analysis** **5.1 Classification of analytical GIS Capabilities** **5.2 Retrieval, classification and measurement**: Measurement, Spatial selection queries,Classification **5.3 Overlay functions:** Vector overlay operators, Raster overlay operators **5.4 Neighborhood functions:** Proximity computations, Computation of diffusion, Flowcomputation, Raster based surface analysis **5.5 Analysis:** Network analysis, interpolation, terrain modelling **5.6 GIS and Application models**: GPS, Open GIS Standards, GIS Applications andAdvances **5.7 Error Propagation in spatial data processing:** How Errors propagate, Quantifyingerror propagation **Course Outcome: CO4, CO6 Teaching Hours : 10 Marks: 12 (R- 04 , U- 02 , A- 06)**
6	**TLO 6.1:** Understand the process of visualizing GIS data. **TLO 6.2:** Learn strategies for effective map visualization. **TLO 6.3**: Use tools for selecting and displaying data. **TLO 6.4:** Learn how to map various types of data. **TLO 6.5:** Design clear and informative maps. **TLO 6.6:** Understand map aesthetics and sharing techniques.	**Data Visualization** **6.1 GIS and Maps, The Visualization Process** **6.2 Visualization Strategies:** Present or explore? **6.3 The cartographic toolbox:** What kind of data do I have? How can I map my data? **6.4 How to map?** How to map qualitative data, How to map quantitative data, How to mapthe terrain elevation, How to map time series? **6.5 Map Cosmetics, Map Dissemination** **Course Outcome: CO5 Teaching Hours: 10 Marks: 10 (R- 04 , U- 04 , A- 02)**

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

NOTE: Total 10 experiments (or turns) out of 15 experiments (or turns)

Sr No	Practical / Tutorial / Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs

1	**LLO**: Install and set up QGIS with vector and raster data	Familiarizing Quantum GIS: Installation of QGIS, datasets forboth Vector and Raster data, Maps.	2	CO1
2	**LLO**: Able to create and manage vector layers and their properties.	Creating and Managing Vector Data: Adding vector layers, setting properties	2	CO3
3	**LLO**: Able to analyze vector data using geometry and attribute tools.	Creating and Managing Vector Data: formatting, calculating line lengths and statistics	2	CO3
4	**LLO**: Able to load and view raster layers in QGIS.	Exploring and Managing Raster data: Adding raster layers, raster styling and analysis.	2	CO3
5	**LLO**: Perform raster mosaicking and merging operations.	Exploring and Managing Raster data: raster mosaicking and clipping	2	CO3
6	**LLO**: Able to 6: Access and use web-based spatial data and download open datasets.	Making a Map, Working with Attributes, Importing Spreadsheetsor CSV files Using Plugins, Searching and Downloading OpenStreetMap Data	2	CO2
7	**LLO**: Able to Work with attribute tables and manage field data.	Working with attributes, terrain Data	2	CO2
8	**LLO**: Able to apply projections and integrate WMS data layers.	Working with Projections and WMS Data	2	CO2
9	**LLO**: Able to Georeference scanned maps and digitize spatial features.	GeoreferencingTopo Sheets and Scanned Maps Georeferencing Aerial Imagery Digitizing Map Data	2	CO4
10	**LLO**: Able to Join and manage tabular data with spatial shapefiles.	Managing Data Tables and Saptial data Sets: Table joins, spatial joins, points in polygon analysis, performing spatial queries	2	CO4
11	**LLO**: Execute spatial queries and basic GIS analyses.	Advanced GIS Operations 1: Nearest Neighbor Analysis, Sampling Raster Data using Points or Polygons, Interpolating Point Data	2	CO6
12	**LLO**: 12. Perform advanced GIS tasks like network and raster-based analysis.	Advance GIS Operations 2: Batch Processing using Processing Framework Automating Complex Workflows using Processing Modeler Automating Map Creation with Print Composer Atlas	2	CO6

13	**LLO**: Able to validate map data	Validating Map data	2	CO5
14	**LLO**: Able to use GIS for mobile application	Demonstrate the Use of GIS in mobile application	2	CO4
15	**LLO**:	Mini project	4	ALL COs
		Total	32	

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

1. Prepare journal of practical.
2. Undertake mini project. Develop a Java application for the requirement given by faculty.
3. Prepare a presentation on the topic given by faculty.

V. Specification Table:

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Introduction to GIS**	2	2	4	8
2	**Data Management and Processing System**	4	2	4	10
3	**Spatial Referencing and Positioning**	2	2	6	10
4	**Data Entry and Preparation**	2	4	4	10
5	**Spatial Data Analysis**	4	2	6	12
6	**Data Visualization**	4	4	2	10
	Total	**18**	**16**	**26**	**60**

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

VII. COs - POs Matrix Form

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

VIII. Suggested Learning Materials / Books

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Principles of Geographic Information Systems- An Introductory Text Book	Geographic Information Systems- An Introductory Text Book Editors: Otto Huisman and Rolf A.	90-6164-226-4
2	Principles of Geographic Information System	P.A Burrough and R.A.McDonnell, Oxford University Press	9780198742845
3	Fundamentals of Spatial Information Systems,	R.Laurini and D. Thompson, Academic Press	9780124383807
4	Fundamentals of Geographic Information Systems	Michael N.Demers Wiley Publications	9780470129067

IX. Learning Websites & Portals

Sr.No	Link / Portal
1	https://www.tutorialspoint.com/software_testing
2	https://www.geeksforgeeks.org/software-testing-basics/
3	www.copado.com/automated tested tools
4	https://www.selenium.dev/

X. Academic Consultation Committee/Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Ms. Nisha Wartha	Lecturer	Government polytechnic Thane
2	Ms. Snehal Salunke	GIS Analyst	Cybertech Systems and Softwares Thane
3	Ms. Namrata A. Wankhade	Lecturer	Government polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of Information Technology

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Head of Department
Department of Information Technology

CDC Co-ordinator
G. P. Mumbai

I/C, Curriculum Development Cell

Principal

Programme: Diploma in Information Technology (Sandwich Pattern)													
Course Code: IT23111					**Course Title: Network and Information Security**								
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**		
3	-	2	1	6	3	20	20	60	25	-	25#	25	175

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

Computer network security is an important aspect in today's world. Now days due to various threats designing security in organization is an important consideration. It is essential to understand basic security principles, various threats to security and techniques to address these threats. The student will be able to recognize potential threats to confidentiality, integrity and availability and also able to implement various computer security policies. This course will introduce basic cryptographic techniques, fundamentals of computer/network security, Risks faced by computers and networks, security mechanisms, operating system security, secure System design principles, and network security principles. Also it will create awareness about IT ACT and different Cyber laws.

II. Course Outcomes: Students will be able to:

CO1	Identify risks related to Computer security and Information hazard in various situations
CO2	Apply user identification and authentication methods.
CO3	Apply cryptographic algorithms and protocols to maintain Computer Security
CO4	Apply measures to prevent attacks on network using firewall.
CO5	Maintain secured networks and describe Information Security Compliance standards.

Course Content Details:

Unit No.	Theory Learning Outcomes (TLO's)aligned to CO's	Topics / Sub-topics
1	**TLO 1.1** Understand concept of Computer Security **TLO 1.2**: Understand Risk and Threat Analysis **TLO 1.3:** Understand Security Threats **TLO 1.4 :** Understand Attacks and its types **TLO 1.5:** Understand Operating System Security and Updates **TLO 1.6:** Understand concept of Information	**Introduction to Computer and Information Security** 1.1 Foundations of Computer Security: Definition and Need of computer security, Security Basics: Confidentiality, Integrity, Availability, Accountability, Non-Repudiation and Reliability. 1.2 Risk and Threat Analysis: Assets, Vulnerability, Threats, Risks, Counter measures. 1.3Threat to Security: Viruses, Phases of Viruses, Types of Virus, Dealing with Viruses, Worms, Trojan Horse, Intruders, Insiders. 1.4 Type of Attacks: Active and Passive attacks, Denial of Service, DDOS, Backdoors and Trapdoors, Sniffing, Spoofing, Man in the Middle, Replay, TCP/IP Hacking, Encryptionattacks. 1.5 Operating system security: Operating system updates: HotFix, Patch, Service Pack. 1.6 Information, Need and Importance of Information, information classification, criteria for information classification, Security, need of security, Basics principles of information security **Course Outcome:CO1** **Teaching Hours :12** **Marks: 12 (R- 06, U- 04 , A- 02)**
2	**TLO 2.1:** Understand concept of Identification and Authentication **TLO 2.2**: Understand Biometrics **TLO 2.3:** Understand Access Controls	**User Authentication and Access Control** 2.1 Identification and Authentication: User name and Password, Guessing password, Password attacks-Piggybacking, Shoulder surfing, Dumpster diving. 2.2 Biometrics: Finger Prints, Hand prints, Retina, patterns, Voice patterns, Signature andWriting patterns, Keystrokes.

		2.3 Access controls: Definition, Authentication Mechanism, Principle-Authentication,Authorization, Audit, Policies: DAC, MAC,RBAC. **Course Outcome:CO2** **Teaching Hours :06** **Marks: 10 (R- 04, U- 04 , A- 02)**
3	**TLO 3.1:** Understand the concept of Cryptography **TLO 3.2:** Understand Different Substitution Techniques **TLO 3.3:** Understand steganography and its procedure **TLO 3.4:** Understand Symmetric and Asymmetric Cryptography	**Cryptography** 3.1 Introduction: Plain Text, Cipher Text, Cryptography, Cryptanalysis, Cryptology,Encryption, Decryption. 3.2 Substitution Techniques: Caesar's cipher, Modified Caesar's Cipher, Transposition Techniques: Simple ColumnarTransposition. 3.3 Steganography: Procedure 3.4 Symmetric and Asymmetric cryptography: Introduction to Symmetric encryption, DES (Dataencryption Standard) algorithm, Asymmetric key cryptography: Digital Signature. **Course Outcome: CO3** **Teaching Hours: 06** **Marks: 10 (R- 02 , U- 04 , A- 04)**
4	**TLO 4.1:** Understand Firewall , need and types. **TLO 4.2:** Understand firewall policies, DMZ, intrusion detection system **TLO 4.3:** Understand vulnerability ,IDS and honeypots.	**Firewall and Intrusion Detection System** 4.1 Firewall: Need of Firewall, types of firewall- Packet Filters, Stateful Packet Filters,Application Gateways, Circuit gateways. 4.2 Firewall Policies, Configuration, limitations, DMZ. Intrusion DetectionSystem 4.3 Vulnerability Assessment, Misuse detection, Anomaly Detection, Network Based IDS,Host-Based IDS, Honeypots **Course Outcome:CO4** **Teaching Hours: 11** **Marks:14 (R- 04 , U- 06, A- 04)**

5	**TLO 5.1:** Understand kerberos **TLO 5.2:**Understand IP Security and its protocols **TLO 5.3**: Understand Email Security **TLO 5.4:** Understand concept of Public key infrastructure **TLO 5.5 :** Understand concept of Cyber Crime **TLO 5.6 :** Understand identity theft, cyber terrorism and laws	**Network Security, Cyber Laws and Compliance Standards.** 5.1 Kerberos: Working, AS, TGS, SS 5.2 IP Security-Overview , protocols-AH,ESP, Modes- transport and tunnel 5.3 Email security- SMTP, PEM, PGP. 5.4 Public key infrastructure (PRI): Introduction, Certificates, Certificate authority,Registration Authority, X.509/PKIX certificate format 5.5 Cyber Crime : Introduction, Hacking digital forgery, cyber stalking/harassment, cyber 5.6 Identity Theft and terrorism, Cyber Delhi Jon, Cyber Laws **Course Outcome: CO5** **Teaching Hours : 10** **Marks: 14 (R- 06 , U- 06 , A- 02)**

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

NOTE: Total 10 experiments (or turns) out of 14 experiments (or turns)

Sr No	Practical / Tutorial / Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
1	**LLO**: Install and Configure different Antivirus Software on system	A]Install and configure Antivirus software on system (any). B]Set up operating system Updates	2	CO1
2	**LLO**: Understand how to perform data backup and restore for data recovery	Perform backup and restore of System	2	CO1
3	**LLO**: Understand to set up passwords	Set up Passwords to operating systems and applications.	2	CO2
4	**LLO** : Understand to apply security	Apply security to the file folder or application using access permissions and verify.)	2	CO2
5	**LLO**: Implement Caeser Cipher	Write a program to implement Caeser Cipher	2	CO3
6	**LLO**: Implement Vernam Cipher	Write a program to implement Vernam Cipher	2	CO3
7	**LLO**: Able to create and verify hash codes	Create and verify Hash Code for given message	2	CO3
8	**LLO**: Able to create and verify digital signature	Create and verify digital signature using tool (e.g. Cryptool)	2	CO3

9	**LLO**: Able to use Steganography	Use Steganography to encode and decode the message using any tool.	2	CO3
10	**LLO**: Install and configure firewall on system	A]Install firewall on any operating system B]Configure firewall settings on any operating system.	2	CO4
11	**LLO**: Able to create and verify digital certificate	Create and verify Digital Certificate using tool (e.g. Cryptool)	2	CO5
12	**LLO**: Able to trace email origin	Trace the origin of Email using any tool(e.g. emailTrackerPro)	2	CO5
13	**LLO**: Able to trace path of web	Trace the path of web site using Tracert Utility	2	CO5
14	**LLO**: Able to understand PGP Email Security	PGP Email Security A] Generate Public and Private Key Pair. B] Encrypt and Decrypt message using key pair.	2	CO5
		Total	28	

IV. Suggested Specifiactions Table(Theory):

Unit No	Topic Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	Introduction to Computer and Information Security	12	06	04	02	12
2	User Authentication and Access Control	06	04	04	02	10
3	Cryptography	06	02	04	04	10
4	Firewall and Intrusion Detection System	11	04	06	04	14
5	Network Security, Cyber Laws and Compliance Standards.	10	06	06	02	14
	Total	45	22	24	14	60

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

1. Prepare journal of practical.
2. Undertake mini project. Develop a Java application for the requirement given by faculty.
3. Prepare a presentation on the topic given by faculty.

VI.AssessmentMethodologies/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 (175)

VII. COs - POs Matrix Form

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

VIII. Suggested Learning Materials / Books

S. No.	Title of Book	Author, Publication	ISBN
1	Computer Security	Dieter Gollmann Wiley Publication, NewDelhi	978-0-470-74115-3
2	Cryptography and Network Security	Atul Kahate McGraw Hill Education,New Delhi	978-1-25-902988-2
3	Cyber Laws and IT Protection	Harish Chander PHI Publication, New Delhi,	978-81-203-4570-6
4	Implementing Information Security based on ISO 27001 / ISO 27002 (Best Practice)	Alan Calder Van Haren Publishing	ISBN-13: 978-9087535414 ISBN-IO: 9087535414

IX.Learning Websites & Portals

Sr.No	Link / Portal
1	https://www.tutorialspoint.com/software_testing
2	https://www.geeksforgeeks.org/software-testing-basics/
3	www.copado.com/automated tested tools
4	https://www.selenium.dev/

X. Academic Consultation Committee/Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organization
1	Mr. Mahendra U. Dabhade	Lecturer	Government polytechnic Thane
2	Mr. Vaibhav A. Wankhade	Database Administrator	FIS Global Pune
3	Ms. Namrata A. Wankhade	Lecturer	Government polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of Information Technology

Head of Department
Department of Information Technology

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CDC Co-ordinator
G. P. Mumbai

I/C, Curriculum Development Cell

Principal

Programme: Diploma in Information Technology (Sandwich Pattern)												
Course Code: IT23403					**Course Title: Project and Seminar**							
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**		
-	-	4	4	8	4				100		50	50	200

Rationale:

The aim of the project is to provide an opportunity to the students to work on an open ended engineering problem. The students will be able to apply knowledge from different areas or courses, which they have studied in their curriculum to a real-world scenario. The scientificway of solving the problems and ability to apply it to find alternative solutions for the problems will help them in their professional life. This course will help to inculcate leadership skills, decision making, participative learning, resource management, cost considerations, documentation and report writing skills with effective communication.

Course Outcomes: Student should be able to:

CO1	Propose projects with innovative ideas in a clear and concise manner
CO2	Identify and summarize an appropriate list of literature review, analyze previous knowledge and relate them to current project
CO3	Plan and coordinate work in a group.
CO4	Implement the skills acquired in the previous semesters to solve complex engineering problems.
CO5	Test the designed project model and evaluate its performance.
CO6	Communicate effectively in oral or written format to present the working of their project/product.

Course Details:

1. Activity plan

Sr.No.	**Activity**	**Week No**
1	Prepare activity plan	1
2	Allocation of work responsibility to individual/team	2
3	Visits to Industries / Institutions / Market/field work/sites	3
4	Collection of Data /Survey/Analysis	4
5	Preparation of preliminary work	5,6
6	Development of Project	7,8,9,10
7	Consolidation of work allotted to individual or team	11

8	Presentation of initial draft: pre submission draft	12
9	Final Project Report: Printed: Submission: soft & Hard copy	13
10	Demonstration of project	14
11	Group presentation of project work at the time of final evaluation	15

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

1. Prepare a presentation on the project topic .

The project work along with project report should be submitted as part of term work in thirdyear fifth semester on or before the term end date.

2. Project Execution:

1. Guide shall monitor the work and help the students from time to time.

2. A project diary is to be maintained by each student, giving details of planning, work executed, information collected etc., on weekly basis and the same should be shown to the guide concerned

4. The guide should maintain a record of progressive / continuous assessment of project work and observe the progress of each group member on weekly basis.

5. The same shall be kept ready for submission to the external examiner before the final examination.

3. Project Report:

1. The student shall get the initial draft copy of the project approved from the Project Guide.

2. Structure: It shall be as follows

Project report structure

- Title page
- Inner title page (white)
- Certificate
- Certificate from Industry
- Index/Content/Intent
- List of Abbreviations/Symbols
- List of Figures
- List of Graphs
- List of Tables
- List of if any other inclusion
- Introduction
- Literature Survey/Review
- System Development
- Performance Analysis
- Conclusion
- References
- Appendices
- Acknowledgement

1. **Introduction (2-3 pages)**

   1.1 Introduction

   1.2 Need/Necessity/Motivation

1.3 Objectives

2. **Literature survey/review (5-10 pages)**

Related information available in standard Books, Journals, Transactions, and InternetWebsites.

3. **System development (20-25 pages)**

- The reporting shall be presented in one or more chapters with appropriate chapter titles.
- Experimental setups, procedures adopted, techniques developed, methodologies adopted. Important derivations/formulae
- Figures and tables should be presented immediately following their first mention in the text.

4. **Performance analysis (5-15)**

- Test results

5. **Conclusions (1 page)**

5.1. Conclusion

5.2. Future Scope

5.3. Applications/Utility

6. **References (1-2 pages)**

- Author, "Title", Name of Journal/Transactions/ Book, Edition/Volume, Publisher, Year of Publication, pp.
- In case of web pages complete web page address with assessing date has to be enlisted
- List of references should be as per use in the text of the report

7. **Appendices (5-7 pages)**

- Related data or specifications or referred charts, details computer
- Code/program, etc.

8. **Acknowledgement** (1 page)

- Expression of gratitude and thankfulness for helping in completion of the said task with names starting from Guide, HoD, Principal and related persons Signed by the candidate.

9. **General Guidelines**

- Text should be printed on front and correct side of the watermark on quality white bond paper
- Paper size□A4
- Font : Times new roman
- Report heading :□ All capital—16 font
- Chapter heading :□ All capital—14 font
- Subchapter :– Title case□12 font
- Sub□subchapter : – First alphabet capital case□12 font

- Content : –Sentence case□12 font
- Title of the Report should not be more than two lines
- Spacing between lines□1.5
- Left Margin 1.5"
- Right Margin 1/2"
- Top Margin 1"

10 Flap

Suitable flap with name of the candidate, Department, Institute, symbol of can be used with nylon strip

CO Vs PO Matrix:

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

Coordinator,
Curriculum Development,
Department of Information Technology

Head of Department
Department of Information Technology

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CDC Co-ordinator
G. P. Mumbai

I/C, Curriculum Development Cell
Government Polytechnic, Mumbai

Principal
Government Polytechnic, Mumbai

Programme: Diploma in Computer Engineering (Sandwich Pattern)												
Course Code: IT23205			**Course Title: Internet Of Things**									
Compulsory / Optional: Compulsory												
Teaching Scheme and Credits						**Examination Scheme**						
									SA		**SLA**	**Total**
CL	**TL**	**LL**	**SLH**	**NLH**	**Credits**	**FA-TH**	**SA-TH (3Hrs.)**	**FA-PR**	**PR**	**OR**		
03	---	04	01	8	4	20	60	25		25#	25	175

Total IKS Hrs. for course: 0

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 30 marks each conducted during the term.
2. SA-TH represents the end term examination.

I. Rationale

Internet of Things is one of the most widely spread market. This course aims at making students able to create Internet of Things at very basic level. After completion of this course, they can go for complicated things which are up in the market. Components used in the course are relatively cheaper to comply with the availability.

Industry / Employer Expected Outcome

Student will be able to

1. learn Embedded systems, protocols, cloud integration
2. Hands-on device design, cloud connectivity, real-world projects

II. Course Outcomes: Students should be able to

CO1	Students will understand the origin, architecture, definitions, and frameworks of IoT along with its applications and challenges.
CO2	Students will gain knowledge of IoT object identification, communication, scalability, interoperability, and enabling technologies like SMAC.
CO3	Students will learn about sensors, actuators, embedded systems, and IoT communication protocols like CoAP and MQTT.
CO4	Students will develop skills in programming and interfacing IoT hardware platforms like Arduino and Raspberry Pi.
CO5	Students will explore IoT business models, innovation, and real-world applications such as smart cities, healthcare, and home automation.

Course Content Details:

Unit No.	Teaching Learning Outcome	Topics / Sub-topics
1	**TLO 1.1** Understand the history and evolution of the Internet of Things. **TLO 1.2** Explain IoT definitions, architecture, and frameworks. **TLO 1.3** Identify IoT applications, motivations, and considerations.	**Introduction to IoT** 1.1 History of IoT, About IoT, Overview and Motivations 1.2 Applications and considerations, Internet of Things Definitions and Frameworks: IoT Definitions, IoT Architecture, 3 views of IoT, IoT Frameworks, 1.3 Basic Nodal Capabilities **Course Outcome: CO1 Teaching Hours: 4 hrs Marks 12**
2	**TLO 2.1** Describe IoT object identification and structural aspects. **TLO 2.2** Explain M2M communications, traffic, and environment characteristics. **TLO 2.3** Analyze scalability, interoperability, security, and privacy issues. **TLO 2.4** Understand key IoT technologies such as SMAC and device intelligence.	**Fundamental IoT Mechanism And Key Technologies** 2.1 Identification of IoT Objects and Services, Structural Aspects of the IoT 2.2 M2M communications, Environment Characteristics, Traffic Characteristics, Scalability, Interoperability, Security and Privacy 2.3 Open Architecture, Key IoT Technologies, Device Intelligence, Communication Capabilities 2.4 SMAC (Social, Mobile, Analytics and Cloud) **Course Outcome: CO2 Teaching Hours : 12 hrs Marks 14**
3	TLO 3.1 Define actuators and their types (Stepper, Servo, etc.). TLO 3.2 Describe sensors and their classifications with examples (LM35, DHT11, LDR, etc.). TLO 3.3 Explain embedded systems and IoT communication protocols (CoAP, MQTT). TLO 3.4 Understand RFID technology, its principles, and components.	**Actuators And Sensors** 3.1 Introduction to Embedded Systems 3.2 What is an actuator? Types of actuators: Stepper Motor, Servo Motor 3.3 What is a sensor?, Types of sensors, Basic sensors like LM35, DHT11, Soil moisture, LDR, Push button, Environmental sensors like MQ2, Medical sensors like pulse sensor. 3.4 Basic communication Protocols COAP, MQTT 3.5 Sensor Technology: RFID, Introduction, Principle of RFID, Components of an RFID system **Course Outcome: CO1 Teaching Hours : 4 hrs Marks 14**

4	**TLO 4.1** Identify Arduino board components and programming basics. **TLO 4.2** Interface sensors and actuators with Arduino. **TLO 4.3** Understand Raspberry Pi hardware and Python programming. **TLO 4.4** Implement IoT applications using microcontrollers and embedded OS.	**Microcontroller And OS – Arduino, Raspberry PI** 4.1 Understanding the Arduino board 4.2 Arduino Programming 4.3 Understanding Raspberry PI 4.4 Raspberry PI programming using Python 4.5 Interfacing of sensors and actuators **Course Outcome: CO3** **Teaching Hours : 10 hrs** **Marks 10**
5	**TLO 5.1** Understand IoT business models and innovation strategies. **TLO 5.2** Explain value creation and business scenarios in IoT. **TLO 5.3** Explore IoT applications in smart metering, healthcare, city automation, automotive, and home automation.	**Business models for the Internet of Things** 5.1 Business Models and Business Model Innovation, Value Creation in the Internet of Things, Business Model Scenarios for the Internet of Things. 5.2 Internet of Things Application: Smart Metering, Advanced Metering Infrastructure, e-Health Body Area Networks 5.3 City Automation, Automotive Applications, Home Automation, Smart Cards, **Course Outcome: CO3** **Teaching Hours : 10 hrs** **Marks 10**

III. Aligned Practical / Tutorial Experiences.

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

NOTE: Total 10 experiments (or turns) out of 18 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 interface temperature sensors with Arduino	Arduino Interfacing using LM35 Temperature sensor	2	CO3
2	LLO: Able to interface light sensors with Arduino	Arduino Interfacing using LDR sensor	4	CO3
3	LLO: Able to interface temperature sensors with Raspberry Pi	Interfacing Raspberry PI with LM35	4	CO3
4	LLO: Able to interface light sensors with Raspberry Pi	Interfacing Raspberry PI with LDR sensor	4	CO3
5	LLO: Able to connect IoT devices using BLE	Interfacing BLE and Mobile Device	4	CO3
6	LLO: Able to send sensor data to IoT cloud platforms	Uploading Raspberry PI LDR sensor data to Thingspeak server	4	CO4

7	LLO: Able to use GSM/GPRS modules for IoT communication	Using GPRS for communication	4	CO4
8	LLO: Able to build RESTful services for IoT	Building REST Calls	4	CO5
9	LLO: Able to interface WiFi module and perform REST calls	Interfacing with 8266 and making REST Calls from device	4	CO3
10	LLO: Able to implement MQTT protocol using Raspberry Pi	Building MQTT Client with Raspberry PI	4	CO4
11	LLO: Able to store and visualize IoT data on server	Sending data to own server and Plotting it	4	CO4, CO5
12	LLO: Able to control actuators remotely over Internet	Controlling Servo motor through Internet	4	CO4
13	LLO: Able to automate home appliances using IoT	Home Automation: controlling LEDs through Internet	4	CO4, CO5
14	LLO: Able to implement vehicle tracking using IoT	Vehicle Tracking	4	CO4, CO5
15	LLO: Able to integrate Arduino with WiFi modules	Interfacing with 8266 and Arduino	6	CO3
		Total	60	

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

1. Control lights from anywhere using a smartphone app.
2. Monitor and adjust room temperatures for maximum comfort and energy efficiency.
3. Home Intrusion Detection
4. Public Transport Tracking

III. Assessment Methodologies/Tools

Formative assessment (Assessment for Learning)

- Rubrics for continuous assessment based on process and product related performance indicators (25 marks)

Summative Assessment (Assessment of Learning)

End term examination, Viva-voce, Workshop performance (25 marks)

IV.Specification Table:

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Introduction to IoT**	2	4	6	12
2	**Fundamental IoT Mechanism And Key Technologies**	4	4	6	14

3	Actuators And Sensors	2	6	6	14
4	Microcontroller And OS – Arduino, Raspberry PI	2	8		10
5	Business models for the Internet of Things		4	6	10
	Total	10	26	36	60

V. 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 Life Long Learning	PSO-1	PSO- 2	PSO-3
CO1	1	3	3	2	-	3	3	2	3	3
CO2	-	3	3	2	-	3	3	3	2	3
CO3	-	3	3	2	-	3	3	2	3	3
CO4	-	3	3	2	-	3	3	2	2	2
CO5	-	3	2	1	-	2	1	2	1	3

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

VI. Suggested Learning Materials / Books

Sr.No	Author	Title	Publisher
1	Schwartz, Marco.	Internet of things with the Arduino Yún	Packt Publishing Ltd, 2014.
2	Building the Internet of Things	Building the Internet of Things	Wiley

VII. Learning Websites & Portals

Sr.No	Link / Portal	Description
1	http://www.w3schools.com/html	
2	https://www.arduino.cc/	
3	https://www.raspberrypi.org/	

VIII. Academic Consultation Committee/Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organization
1	Mr. Rajesh Patil	Lecturer in Electronics Engineering	Government Polytechnic kolhapur
2	Prof. Nikhil B. Khandare	Assistant Professor	Department of MCA, VJTI, Mumbai
3	Ms. N.A. Wankhade	Lecturer in Information Technology	Government Polytechnic Mumbai

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CDC Co-ordinator
G. P. Mumbai

Coordinator,
Curriculum Development,
Department of Information Technology

Head of Department
Department of Information Technology

I/C, Curriculum Development Cell

Principal

Programme: Diploma in Information Technology (Sandwich Pattern)													
Course Code: IT23208					**Course Title: Software Testing And Quality Assurance**								
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**		
3	-	4	1	8	4	20	20	60	25		25#	25	175

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

Software testing is a process, to evaluate the functionality of a software application with an intent to find whether the developed software met the specified requirements or not and to identify the defects to ensure that the product is defect free in order to produce the quality product. student will learn how to immediately find problems in any computer program, how to plan an effective test approach, how to clearly report your finding and how to tell when your software is ready for release.Industry / Employer Expected Outcome

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

CO1	Understand software testing concept and importance of Quality software
CO2	Use the different software testing approach
CO3	Understand different levels of testing .
CO4	Understand STLC, test planning, test case writing and test case execution.
CO5	Identify and fix various defects/bugs.
CO6	Use the various automated testing tools to improve testing efficiency and overcome limitation of Manual testing

Course Content Details:

Unit No.	Theory Learning Outcomes (TLO's)aligned to CO's	Topics / Sub-topics
1	**TLO 1.1** Recall concept of software testing **TLO 1.2**: understand testing importance with some basic concepts. **TLO 1.3:** Understand different terminology in ST **TLO 1.4:** Identify objectives of ST. **TLO 1.5:** Understand working ETVX model **TLO 1.6:** Identify skills required for software tester.	**Basics of Software Testing** 1.1 Definition of Software Testing, what is Quality? Software Quality, Role of Testing 1.2 Failure, Error, Fault, Defect, Bug Terminology 1.3 Objectives of Testing 1.4 Test Case 1.5 When to Start and Stop Testing of Software (Entry and Exit Criteria) 1.6 Skills for Software Tester, SDLC 1.7 Quality Assurance, Quality Control, Verification and Validation, **Course Outcome: CO1** **Teaching Hours: 04 hrs** **Marks: 06**
2	**TLO 2.1:** Understand white and black box testing **TLO 2.2**: Understand different types of testing techniques. **TLO 2.3:** Understand testing with examples	**Types of Testing** 2.1 White Box Testing : Classification of White Box Testing 1. Static Testing- Inspections, Structured Walkthroughs, Technical Review 2. Structural Testing-Code Functional Testing, Code Coverage Testing, Code Complexity Testing 2.2 Black Box Testing: 2.2.1 Requirement Based Testing, 2.2.2 Positive and Negative Testing, 2.2.3 Boundary Value Analysis, 2.2.4 Decision Tables, 2.2.5 Equivalence Partitioning, 2.2.6 User Documentation Testing, 2.3 Sample Examples on White and Black Box Testing **Course Outcome: CO2** **Teaching Hours: 10hrs** **Marks: 14**

3	**TLO 3.1:** Understand the levels of testing **TLO 3.2:** Understand the types of Integration testing . **TLO 3.3:** understand system and acceptance level testing **TLO 3.4:** Understand different special testing . .	**Levels of Testing and Special Tests** 3.1 **Unit Testing**: Driver, Stub 3.2**IntegrationTesting**: Decomposition Based Testing – Top-Down Integration, Bottom-Up Integration, Bi-Directional Integration, Incremental Integration, Non-Incremental Integration 3.3 **System Testing**: Recovery Testing, Security Testing, Performance Testing, Load Testing, Stress Testing, Usability Testing, Compatibility Testing 3.4 **Acceptance Testing**: Acceptance criteria, Alpha Testing an Beta Testing 3.5 **Special Tests**: Smoke Testing and Sanity Testing, Regression Testing, Usability Testing, GUI Testing, Object Oriented Application Testing: Client-Server Testing, Web based Testing **Course Outcome: CO3** **Teaching Hours: 10 hrs** **Marks: 14**

4	**TLO 4.1:** Understand, SDLC process. **TLO 4.2:** Create Test Cases for different testing. **TLO 4.3:**Understand process of test management. **TLO 4.4** : understand process of Test Summary Report	**Test Management** 4.1 Test Planning STLC(software testing life cycle) Preparing a Test Plan, Scope Management, Deciding Test Approach, Setting Up Criteria for Testing, Identifying Responsibilities, Staffing, Training Needs, Resource Requirements, Test Deliverables, Testing Tasks 4.2 Test Management: Choice of Standards, Test Infrastructure Management, Test People Management, Integrating with Product Release 4.3 Test Process: Base Lining a Test Plan, Test Case Specification, Update of Traceability 4.4 Test Reporting: Recommending Product Release. Matrix, Executing Test Cases, Collecting and Analyzing Metrics, Preparing Test Summary Report **Course Outcome: CO4** **Teaching Hours: 08 hrs** **Marks: 10**
5	**TLO 5.1:** Understand defect in testing **TLO 5.2:** Understand process of Defect Life Cycle **TLO 5.3**: Understand impact of defect and defect report.. .	**Defect Management** 5.1 Introduction, Defect Classification, Defect Management Process 5.2 Defect Life Cycle, Defect Template 5.3 Estimate Expected Impact of a Defect, Techniques for Finding Defects, Reporting a Defect **Course Outcome: CO5** **Teaching Hours: 06 hrs** **Marks: 8**
6	**TLO 6.1:** Understand limitations of Manual testing **TLO 6.2:** Understand need of Automated testing **TLO 6.3**: comparison of Manual and Automated Testing. **TLO 6.4:** Understand testing tools. **TLO 6.5:** Understand working of tools and different matrix.	**Testing Tools and Measurements** 6.1 Limitations of Manual Testing and Need for Automated Testing tools, What is Automation Testing?, Manual Testing vs Automation Testing, Automation testing Tools 6.2 Features of Test Tool: Guideline for Static and Dynamic Testing Tool 6.3 Advantages and Disadvantages of Using Tools 6.4 Selecting a Testing Tool 6.5 When to Use Automated Test Tools, Testing Using Automated Tools

		6.6 What are Metrics and Measurement: Types of Metrics, Project Metrics, Progress and Productivity Metrics **Course Outcome: CO6** **Teaching Hours: 07 hrs** **Marks: 08**

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

NOTE: Total 10 experiments (or turns) out of 18 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 create test cases using positive negative testing	Study system specification & designing test cases for Inventory & purchase order management. (Min 20 Test case)	2	CO1
2	**LLO**: Able to design cases as white box testing	Design and write test cases for simple calculator application	4	CO1, CO2
3	**LLO**: Able to perform test cases as acceptance testing	Design and write test cases for ATM. (Min 20 Test case).	4	CO1, CO2
4	**LLO**: Able to create test cases for GUI	Design test write test cases for Notepad (MS Window based) Application.	2	CO1, CO2
5	**LLO**: Able to create test Cases for GUI .	Design test cases for Social site (Twitter, Face book) login form. (Write test cases in test case format) and prepare a bug report document.	2	CO1, CO2
6	**LLO**: Able to create teat cases for decision making testing.	Design test cases for Amazon 1.Amazon Search Functionality Test Cases 2. Amazon Login Screen Test Cases 3. Amazon Search Box Button Test Case	4	CO3, CO4
7	**LLO**: Able to create teat cases for decision making testing.	Write the test cases for any known application and prepare bug report document. (eg. Banking Application)	2	CO3, CO4
8	**LLO**: Able to understand automated testing tool	Study of Automated Testing Tools.(Bugzilla, Selenium, Mentis, QTP, or any freeware tool)	2	CO3, CO4
9	**LLO**: Able to perform testing using tool	Using an Automated/ computerized tool, Atomizing and running test cases for MS-Paint application (MS Windows based).	2	CO3, CO4

10	**LLO**: Able to understand testing infrastructure	Design the test cases for setting up of company Infrastructure.	2	CO3, CO4
11	**LLO**:Able to create teat cases for requirement based testing	Implement test cases for MS Word application using an Automation Tool	4	CO5
12	**LLO**: Able to understand and structural testing	Create a test plan document for Library Management System	4	CO5
13	**LLO**: Able to understand and structural testing	Design test cases for college Admission form. (Write test cases in test case format)	2	CO5
14	**LLO**: Able to create test Cases for white and black box testing	Design test cases for flip-kart purchase management system using automatic tool	4	CO6
15	**LLO**: Able to understand importance for tesing.	Mini project -Test Your Final Year Project using all types of testings and prepare report	6	CO6
		Total	60	

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

1. Prepare journal of practical.
2. Undertake mini project. Develop a Java application for the requirement given by faculty.
3. Prepare a presentation on the topic given by faculty.

V. Specification Table:

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Basics of Software Testing**	2	4		6
2	**Types of Testing**	4	4	6	14
3	**Levels of Testing and Special Tests**	2	6	6	14
4	**Test Management**	2	8		10
5	**Defect Management**		4	6	10
6	**Testing Tools and Measurements**	4	2		6
Total		**14**	**28**	**18**	**60**

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

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	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
CO6	3	3	3	1	-	1	3	1	2	2
CO7	3	3	-	2	-	1	2	3	2	3

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

VIII. Suggested Learning Materials / Books

Sr.No	Author/ Publisher	Title	ISBN
1	Software Testing: Principles and Practices	Srinivasan Desikan - Gopalaswamy Ramesh	9788177581218
2	Software Testing: Principles, Techniques and Tools	M. G. Limaye Tata McGraw-Hill	9780070139909
3	Software quality Assurance, testing and metrics	Anirban Basu Phi Learning	978-81-203- 5068-7

IX. Learning Websites & Portals

Sr.No	Link / Portal
1	https://www.tutorialspoint.com/software_testing
2	https://www.geeksforgeeks.org/software-testing-basics/
3	www.copado.com/automated tested tools
4	https://www.selenium.dev/

X. Academic Consultation Committee/Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organization
1	Ms.Dipali Gosavi	Lecturer Information Technology Department	Government Polytechnic, Mumbai
2	Mr.Rohan Gopale	Software Quality Assurance	India First Life
3	Mr.Ulka Katekar	Software Engineer	TCS

Coordinator,
Curriculum Development,
Department of Information Technology

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CDC Co-ordinator
G. P. Mumbai

Head of Department
Department of Information Technology

I/C, Curriculum Development Cell

Principal

Programme : Diploma in Computer Engineering and Information Technology (Sandwich Pattern)												
Course Code: CO23604					**Course Title: Mobile Application Development**							
Compulsory / Optional: Compulsory												
Teaching Scheme and Credits						**Examination Scheme**						
CL	**TL**	**LL**	**SLH**	**NLH**	**Credits**	**FA-TH**	**SA-TH (02.30 Hrs.)**	**FA-PR**	**SA**		**SLA**	**Total**
									PR	**OR**		
02	--	04	--	06	03	--	--	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, *# Online 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

Mobile Application Development has been a source of different opportunities and challenges for soft developers since last decade. Although there very few platforms are available for application development, Android OS being open source has become very popular and widely used platform among all. This course aims at making students able to develop professional quality Android Apps and generate revenue out of it.

II. Industry / Employer Expected Outcome

Students will be able to

1. Understand the Mobile Operating Systems
2. Understand why to learn Android OS
3. Understand Android Platform Architecture
4. Understand basic concepts of Android App Development
5. Develop Android Apps to solve real world problems
6. Deploy Android Apps for public
7. Earn revenue out of the App Deployment

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

CO1	Decide the appropriate version of Android OS to be used for App Development
CO2	Develop Android Apps using UI Components and Event Listeners
CO3	Perform Remote Database Operations using Firebase
CO4	Develop Apps using NavigationDrawer and RecyclerView
CO5	Access hardware and sensors for the App Development

IV. Course Content Details:

Unit No.	Theory Learning Outcomes	Topics / Sub-topics
1	TLO1.1: Understand latest trends in Mobile Application Development TLO 1.2: Understand different platforms in Mobile Application Development TLO 1.3: Understand why to learn Android TLO 1.4: Understand Android Studio, Android versions, SDK Manager and Android Project Structure	**Introduction** 1.1 Latest Trends in Mobile Application Development 1.2 Different Platforms in Mobile Application Development: Apple iOS, Windows Mobile OS and Android OS Architecture 1.3 Why Android? 1.4 Installing Android Studio 1.5 Android versions: features and limitations, number of devices currently running on each version and how to choose a specific version for a given App Development 1.6 Android SDK Manager 1.7 Android Project Structure 1.8 Create "Hello Android World" application **Course Outcome: CO1 Teaching Hours : 2 hrs**
2	TLO 2.1: Understand Android Platform Architecture TLO 2.2: Understand Logical components of Android app TLO 2.2: Understand Android Tool Repository TLO 2.3: Understand Files: Manifest, Java, Res, Gradle TLO 2.4: Understand AVD Creation TLO 2.5: Run Apps on an Android Phone TLO 2.6: Publish Apps on Google Play Store or on website	**Android Architecture** 2.1 Android Platform Architecture 2.2 Logical components of Android app 2.3 Android Tool Repository 2.4 Files: Manifest, Java, Res, Gradle 2.5 AVD Creation 2.6 Running Apps on an Android Phone 2.7 Publishing Apps on Google Play Store or on website **Course Outcome: CO1 Teaching Hours : 2 hrs**
3	TLO 3.1: Understand XML Design TLO 3.2: Understand Activity life cycle TLO 3.3: Use Layouts: RelativeLayout, LinearLayout TLO 3.4: Use UI resources, String resources, Image resources TLO 3.5: Use Views: Button, TextView, ImageView, EditText, Checkbox, Spinner, Date and Time Picker, ListView TLO 3.6: Understand Event handling associated with Views, AlertDialog, Navigation between Activities, ActionBar TLO 3.7: Use Intents and its types TLO 3.8: Use Menu: Popup, Context, Option TLO 3.9: Use Fragments, Fragment Life cycle, Interaction between Fragments TLO 3.10: Use Types of Animations on Views: Scale, Rotate, Translate, Alpha	**UI Components and Event Listeners** 3.1 Overview of XML Design 3.2 Activity life cycle 3.3 Layouts: RelativeLayout, LinearLayout 3.4 UI resources, String resources, Image resources 3.5 Views: Button, TextView, ImageView, EditText, Checkbox, Spinner, Date and Time Picker, ListView 3.6 Common attributes of View 3.7 Event handling associated with Views, AlertDialog, Navigation between Activities, ActionBar 3.8 Intents 3.8.1 Implicit Intents: Share, Dial Number 3.8.2 Explicit Intents: Splash, Activity to Activity 3.9 Menu: Popup, Context, Option 3.10 Fragments, Fragment Life cycle, Interaction between Fragments 3.11 Types of Animations on Views: Scale, Rotate, Translate, Alpha **Course Outcome: CO2 Teaching Hours : 6 hrs**

4	TLO 4.1: Use Internal and External Data Storage in Android TLO 4.2: Use SharedPreferences in Android TLO 4.3: Understand Persistent data storage in Android TLO 4.4: Perform remote database operation using Firebase	**Data Storage Management** 4.1 Internal and External File storage Operation 4.2 Shared Preference 4.3 How to use Shared Preferences 4.4 Maintain login session using Shared Preferences 4.5 SQLite database 4.6 Firebase and Remote Database Operations 4.7 Notifications using Firebase **Course Outcome: CO3 Teaching Hours : 4 hrs**
5	TLO 5.1: Use NavigationDrawer in Android TLO 5.2: Use RecyclerView in Android	**NavigationDrawer and RecyclerView** 5.1 What is NaigationDrawer? 5.2 Adding /menu to NavigationDrawer 5.3 Customizing NvigationDrawer 5.4 RecyclerView 5.5 Creating ListView and GridView using RecyclerView 5.6 LayoutManager in RecyclerView **Course Outcome: CO4 Teaching Hours : 4 hrs**
6	TLO 6.1: Access Internet, calls and messages in Android Apps TLO 6.2: Access Multimedia in Android Apps TLO 6.3: Access Bluetooth, WiFi and GPS in Android Apps TLO 6.4: Access sensors and sensor data in Android Apps	**Accessing Hardware/ Sensors and Sensor Data** 6.1 Internet, Call, Messages 6.2 Multimedia: Audio, Video, Camera 6.3 Bluetooth, Wifi, GPS 6.4 Sensors 6.4.1 Motion Sensors: Gyroscope, Accelerometer, Gravity Sensor 6.4.2 Position Sensors: Orientation Sensors, Magnetometers, Proximity Sensor 6.4.3 Environmental Sensors: Ambient Air Temperature, Pressure, Illumination, Humidity 6.5 Sensor Framework and Best Practices for accessing Sensor and Sensor Data **Course Outcome: CO5 Teaching Hours : 12 hrs**

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

Sr No	Laboratory Learning Outcome	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
1	LLO 1: Download Install and Configure Android Studio on Windows/ Linux environment.	Download Install and Configure Android Studio on Windows/ Linux environment.	04	CO1
2	LLO 2: Building Simple User Interface using UI Widgets, Layouts and Adapters. Use Material Design Pattern.	Building Simple User Interface using UI Widgets, Layouts and Adapters. Use Material Design Pattern.	04	CO2
3	LLO 3: Develop an application having animation on views.	Develop an application having animation on views.	04	CO2
4	LLO 4: Develop an Android App in which a user can register. After registration user can login with the credentials supplied for registration using Firebase.	Develop an Android App in which a user can register. After registration user can login with the credentials supplied for registration using Firebase.	06	CO3

5	LLO 5: Develop an Android App to your college display a NavigationDrawer with Menus like About Us, Departments, Student Section, Contact Us, etc.	Develop an Android App to your college display a NavigationDrawer with Menus like About Us, Departments, Student Section, Contact Us, etc.	04	CO4
6	LLO 6: Design an android based application to display contact list in RecyclerView	Design an android based application to display contact list in RecyclerView	06	CO4
7	LLO 7: Develop an application to make and receive calls on mobile.	Develop an application to make and receive calls on mobile.	04	CO5
8	LLO 8: Design an android based application to take a snapshot by using the Camera in your mobile.	Design an android based application to take a snapshot by using the Camera in your mobile.	04	CO5
9	LLO 9: Develop an application to access Bluetooth and Wi-Fi.	Develop an application to access Bluetooth and Wi-Fi.	04	CO5
10	LLO 10: Design an android based application to demonstrate GPS services using Google Maps.	Design an android based application to demonstrate GPS services using Google Maps.	04	CO5
11	LLO 11: Develop an application to access Accelerometer, Gyroscope, Orientation Sensors and to display data received from each sensor.	Develop an application to access Accelerometer, Gyroscope, Orientation Sensors and to display data received from each sensor.	06	CO5
12	LLO 12: Publish all the above apps on your own website. (To be performed side by side along with all the experiments above)	Publish all the above apps on your own website. (To be performed side by side along with all the experiments above)	02	CO1`
13	LLO 13: Mini Project (To be performed side by side along with all the experiments above)	Mini Project (To be performed side by side along with all the experiments above)	08	ALL

Note: if any

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

1. Micro Project

   (To be performed side by side along with all the experiments above)

VII. Specification Table: NA

VIII. Assessment

Methodologies/Tools

Formative assessment (Assessment for Learning)

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

Summative Assessment (Assessment of Learning)

- End term examination, Viva-voce, Workshop performance (__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 and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	01	02	03	01	-	01	03	01	02	02
CO2	01	03	03	02	-	03	03	02	02	03
CO3	01	03	03	02	-	03	03	03	03	03
CO4	-	03	03	02	01	03	03	03	03	03
CO5	-	03	03	02	01	03	03	03	03	03

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

X. Suggested Learning Materials / Books: NA

XI. Learning Websites & Portals

Sr.No	Link / Portal	Description
1	https://developer.android.com/docs	Link for official documentation website for Android Development
2	https://developer.android.com/guide/topics/manifest/uses-sdk-element#ApiLevels	Link for understand which API level to use while developing Android App
3	https://developer.android.com/guide/topics/sensors/sensors_overview	Link to overview sensor for Android App Development

XII. Academic Consultation Committee/Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organization
1	Mr. Vivek Pawar	Director and CEO	Atoconn Systems Pvt. Ltd.
2	Prof. Nirmala Shinde-Baloorkar	Assistant Professor, Department of Computer Engineering	K. J. Somaiya College of Engineering
3	Mrs. Jijnasa S. Patil	Lecturer in Computer Engineering	Government Polytechnic, Mumbai

Coordinator,
Curriculum Development,
Department of Computer Engineering

APPROVED COPY

Head of Department
Department of Computer Engineering

CDC Co-ordinator
G. P. Mumbai

I/C, Curriculum Development Cell
Government Polytechnic, Mumbai

Principal
Government Polytechnic, Mumbai