

Government Polytechnic, Pune
(An Autonomous Institute of Government of Maharashtra)

Department of Computer Engineering

Level V - B Curriculum

Diversified Courses

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diploma in Computer Engineering, Diploma in Information Technology
Programme code	01/02/03/04/05/ 06/07 /08/15/16/17/18/19/21/22/23/24/ 26
Name of Course	Digital Forensics and Ethical Hacking
Course Code	CM5106
Prerequisite course code and name	NA
Class Declaration	Yes

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
L	T	P			Theory		Practical		Total Marks
			C		ESE	PA	\$ESE	PA	
				Marks	80	20	25	25	150
03	00	02	05	Exam Duration	3 Hrs.	1 Hr.			

Legends: L- Lecture, P- Practical, T- Tutorial, C- Credit, ESE-End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, \$- Oral Exam, #- Online Examination each Lecture/Practical period is of one clock hour

2. RATIONALE

Digital forensic investigation plays a vital role in predicting and analyzing the digital crime. It is procedure of preservation, identification, analysis and report making of digital evidence stored as data on magnetically encoded information. The data resides in the computer in a hidden way such that only special forensic software tools and standard procedures can fetch/retrieve it. Hacking outlines computer hacker tricks and techniques that one can use to access the security of information system, find vulnerabilities that matter and fix the weaknesses before the criminal hackers and malicious insiders take advantage of them. Ethical hacking is the professional and legal types of security system. So, this course will enable the students to employ security measures and keep an external hackers and malicious users in check.

3. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Locate digital evidences in cyber breaches and use ethical hacking techniques as preventive measures.**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

1. Describe Models of Digital Forensic Investigation.
2. Locate the digital evidences in file system.
3. Follow Evidence handling procedures.
4. Select relevant tools for hacking.
5. Detect system and network vulnerabilities.
6. Apply Hacking Methodologies to get into the system.

5. SUGGESTED PRACTICALS/ EXERCISES

S. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approx. Hrs. Required
1.	1	a. Monitor CPU Utilization* and Memory Utilization for detecting unauthorized process activations. *Hint: More CPU utilization as compared to Memory is an indicator of anomaly	1, 2	02
	1 2	b. Create complete memory dump using windows. c. Read Memory Dump Using Windows Driver toolkit.		02
2.	1	Crack passwords using password cracking tools like <i>LC4/John the Ripper/pwdump</i> or any equivalent.	1	02
3.	2	Read and Interpret* Operating Systems logs on Windows/Linux file system. *Hint: Check whether the log gives information about file systems. Any such entry indicates some malicious activity.	2	02
4.	2	Install Kali Linux.	2	02
5.	3	Collect live data on Windows: a) Create a response toolkit on windows having utility <i>cmd.exe, PsLoggedOn, netstat</i>	3	02
		b) Establish TCP connection between forensic workstation and the target system using <i>netcat</i>		02
		c) Run trusted <i>cmd.exe</i> , identify logged users and remote access users, Record creation, access times and all the modifications made to the files		02
6.	5	a) Check whether Email is a spam by analyzing the Email Header b) Install software like SpamAssasin (an antispam platform) c) Read and analyze Email Header using software like SpamAssasin	5	02
7.	4, 6	a) Install Wireshark tool on Windows/Kali Linux	4, 6	02
		b) Use Wireshark tool to capture network traffic and to understand three-way handshaking concept/Analyze the packet.		02
8.	5,6	Perform port scanning using <i>nmap</i> utility to test whether ports are listening and vulnerable .	5, 6	02
9.	5	Perform Arp poisoning on Kali Linux using <i>Etercap</i> or equivalent tool.	5	02
10.	5	Establish DoS attack using TCP/ICMP flooding:	5	

S. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approx. Hrs. Required
		a) Ping continuously a particular machine at a time from different machines and observe the machine behavior on Network.		02
		b) Write shell script for continuously flooding a Machine with ping and observe the machine behavior on Network.		02
11.	All	Micro-project (Refer point 11 for micro project list)	All COs	02
		Total		32

S. No.	Performance Indicators	Weightage in %
a	Configuration of Windows/Kali Linux operating system	40
b	Use of different digital forensic and ethical hacking tools	40
c	Submit journal report in time	20
	Total	100

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name / Instruments required	Experiment Sr. No.
1	Computer system (Any computer system with basic configuration)	All
2	Windows/Linux operating system.	
3	Digital Forensic and Hacking Tools preferably Open source as mentioned in practical's	

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Section I	
Unit - I: Basics of Digital Forensics (Weightage-12 , Hrs-06)	
1a. Explain the given rule of digital forensic. 1b. Describe the given model of digital forensic investigation. 1c. Identify whether the given issue in digital forensics is ethical or unethical 1d. Explain characteristics of the given Model of Digital Forensic Investigation.	1.1 Digital forensics: Digital forensic History of forensic, Rules of digital forensic, Digital forensics investigation and its goal 1.2 Models of Digital Forensic Investigation: DFRWS Investigative Model, Abstract Digital Forensics Model (ADFM), Integrated Digital Investigation Process (IDIP), End-to-End digital investigation process (EEDIP), An extended model for cybercrime investigation, UML modeling of digital forensic process model (UMDFPM) 1.3 Ethical issues in digital forensic: General ethical norms for investigators, Unethical norms for investigation.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit - II: Hardware and Software Environments(Weightage-12 , Hrs- 08)	
<p>2a. Describe the given nature of digital information.</p> <p>2b. Show relationship between different categories in the given file system.</p> <p>2c. Write steps to locate the given evidence in file system.</p> <p>2d. Describe the indicators of integrity for the given information.</p>	<p>2.1 Computers and the nature of digital information: Magnetic hard drives and tapes, Optical media storage devices, Random-access memory (RAM), Solid-state drive (SSD) storage devices, Network-stored data, The cloud</p> <p>2.2 File systems that contain evidence: file system category, filename category, metadata category, content category</p> <p>2.3 Locating evidence in file systems: Determining the means of transgression, opportunity to transgress, and the motive to transgress, Deciding where to look for possible evidence, Indexing and searching for files, Unallocated data analysis</p> <p>2.4 Password security, encryption, and hidden files: User access to computer devices importance of information confidentiality, information integrity, and information availability, User access security controls, Encrypted devices and files</p>
Unit - III: Digital Evidence(Weightage-16 , Hrs- 10)	
<p>3a. Describe the given rule of digital evidence.</p> <p>3b. Explain characteristics of the given type of digital evidence.</p> <p>3c. Explain features of the given Challenge in evidence handling.</p> <p>3d. Describe the given evidence handling procedure.</p>	<p>3.1 Digital Evidences: Definition, Best Evidence Rule, Original Evidence</p> <p>3.2 Rules of Digital Evidence</p> <p>3.3 Characteristics of Digital Evidence: Locard's Exchange Principle, Digital Stream of bits</p> <p>3.4 Types of evidence: Illustrative, Electronics, Documented, Explainable, Substantial, Testimonial</p> <p>3.5 Challenges in evidence handling: Authentication of evidence, Chain of custody, Evidence validation</p> <p>3.6 Volatile evidence</p> <p>3.7 Evidence handling procedure: Evidence system description, digital photos, evidence tag, evidence label, evidence storage, evidence log, working copies, evidence backup, evidence disposition, evidence custodial audit, evidence safe, shipping evidence media</p> <p>3.8 Ethical issues/legal principle of digital evidence: Circumstantial and hearsay nature of Digital Evidence, Authorization to conduct Digital Forensics investigation, authenticity of digital evidence, scientific method</p> <p>3.9 Digital Evidence and metadata</p>

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Section II	
Unit - IV: Basics of Hacking(Weightage-14 , Hrs-08)	
<p>4a. Explain the features of the given type of attack on computer system.</p> <p>4b. Describe the features of the given ethical hacking principle to be obeyed.</p> <p>4c. Explain the process of ethical hacking for the given problem.</p> <p>4d. Classify the given component of cracking the Hacker Mindset.</p>	<p>4.1 Ethical Hacking: How Hackers Beget Ethical Hackers, Defining hacker, Malicious users</p> <p>4.2 Understanding the need to hack your own systems</p> <p>4.3 Understanding the dangers your systems face: Nontechnical attacks, Network-infrastructure attacks, Operating-system attacks, Application and other specialized attacks</p> <p>4.4 Obeying the Ethical hacking Principles: Working ethically, Respecting privacy Not crashing your systems</p> <p>4.5 Ethical hacking Process: Formulating plan, Selecting tools, Executing the plan, Evaluating results</p> <p>4.6 Cracking the Hacker Mindset: What You're Up Against? Who breaks in to computer systems, Identifying the purpose of hacking, Planning and Performing Attacks, Maintaining Anonymity</p>
Unit - V: Types of Hacking(Weightage-14 , Hrs-08)	
<p>5a. Describe the characteristics of the given type of Network Infrastructure Vulnerability.</p> <p>5b. Explain features of the given type of operating system Vulnerability.</p> <p>5c. Describe the given type of best practice followed to minimize e-mail security risk.</p> <p>5d. Describe the given type of best practice followed to minimize Database Vulnerability.</p>	<p>5.1 Network Hacking Network Infrastructure:</p> <ul style="list-style-type: none"> • Network Infrastructure Vulnerabilities, • Scanning-Ports, Ping swiping • Scanning SNMP, Grabbing Banners • Analysing Network Data and Network Analyzer, MAC-daddy attack <p>Wireless LANs:</p> <ul style="list-style-type: none"> • Implications of Wireless Network Vulnerabilities, • Wireless Network Attacks <p>5.2 Operating System Hacking</p> <ul style="list-style-type: none"> • Introduction of Windows and Linux Vulnerabilities <p>5.3 Applications Hacking Messaging Systems</p> <ul style="list-style-type: none"> • Vulnerabilities, E-Mail Attacks- E-Mail Bombs, Banners, • Best practices for minimizing e-mail security risks <p>Web Applications:</p> <ul style="list-style-type: none"> • Web Vulnerabilities, Directories Traversal and Countermeasures <p>Database system</p> <ul style="list-style-type: none"> • Database Vulnerabilities • Best practices for minimizing database security risks

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit - VI: Ethical Hacking Plan and Hacking Methodologies (Weightage-12 , Hrs-08)	
6a. Write steps to develop ethical hacking plan 6b. Select appropriate security assessment tool. 6c. Describe hacking methodologies 6d. Describe vulnerabilities in the system.	6.1 Developing Ethical Hacking Plan <ul style="list-style-type: none"> Establishing your Goal Determining which system to hack Creating testing standards Selecting security assessment tools 6.2 Hacking Methodologies <ul style="list-style-type: none"> Setting the stage for testing Seeing what others see Scanning systems Determining what's running on open ports Assessing vulnerabilities Penetrating the system

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
Section I						
I	Basics of Digital Forensics	06	04	06	02	12
II	Hardware and Software Environments	08	02	04	06	12
III	Digital Evidence	10	02	08	06	16
	Total	24	08	18	14	40
Section II						
IV	Basics of Hacking	08	02	08	04	14
V	Types of Hacking	08	02	08	04	14
VI	Ethical Hacking Plan and Hacking Methodologies	08	02	06	04	12
	Total	24	06	22	12	40
	Total	48	14	40	26	80

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

- a. Prepare journals based on practical performed in laboratory.
- b. Prepare report on suggestive case study of digital forensic as give below:
 - i. The Aaron Caffrey case – United Kingdom, 2003
<http://digitalcommons.law.scu.edu/cgi/viewcontent.gi?article=1370&context=chtlj>
 - ii. The Julie Amero case – Connecticut, 2007
<http://dfir.com.br/wp-content/uploads/2014/02/julieamerosummary.pdf>
 - iii. The Michael Fiola case – Massachusetts, 2008
<http://truthinjustice.org/fiola.htm>.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

- a. Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
- b. About **15-20% of the topics/sub-topics** which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the COs through classroom presentations.
- c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
- d. Use different Audio-Visual media for Concept understanding.
- e. Guide student(s) in undertaking micro-projects.
- f. Demonstrate students thoroughly before they start doing the practice.
- g. Observe continuously and monitor the performance of students in Lab.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should **not exceed three**. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. (Affective Domain Outcomes). Each student will have to maintain activity chart consisting of individual contribution in the project work and give a seminar presentation of it before submission. The student ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

- a. Study any Trojan attack. Identify the Trojan attack:
 - i. State the way trojan got installed on particular Machine.
 - ii. State the effects of the Trojan.
 - iii. Elaborate/Mention/State protection/Blocking mechanism for this specific Trojan, example specification of any anti-threats platform which filters the Trojan.
- b. Study Credit card fraud as an identity threat. Identify:
 - i. Use of digital media in carrying out fraud.
 - ii. Vulnerability Exploited.
 - iii. Effect of fraud.
 - iv. Protection/Precaution to be taken against such frauds.
- c. Study any case of forgery /falsification crime case solved using digital forensics:
 - i. Identify the model used for Digital Investigation.
 - ii. Was investigation done ethically or unethically?
 - iii. Where does digital evidence found for crime establishment?
 - iv. State the punishment meted.
- d. Study any case of fake profiling. Identify
 - i. The way digital forensics was used in detecting the fraud.
 - ii. Where was digital evidence located?
 - iii. Effects.

12. SUGGESTED LEARNING RESOURCES

S. No.	Title	Author	Publisher, Edition, and Year of publication, ISBN Number
1	Digital Forensic	Jain, Nilakashi Kalbande, Dhananjat R.	Wiley Publishing, New Delhi, 2017 • ISBN: 978-81-265-6574-0
2	The Basics of Digital Forensic	Sammons, John	Elsevier, Netherlands • ISBN 978-1-59749-661-2
3	Hacking for Dummies	Kevin Beaver CISSP	Wiley Publishing, New Delhi • ISBN: 978-81-265-6554-2

13. SOFTWARE/ LEARNING WEBSITES

1. <https://resources.infosecinstitute.com/digital-forensics-models/#gref>.
2. <https://docs.microsoft.com/en-us/sysinternals/downloads/psloggedon>
3. <https://docs.kali.org/introduction/download-official-kali-linux-images>
4. www.openwall.com/passwords/windows-pwdump

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	3	1	2	1	2
CO2	2	2	-	-	1	1	3
CO3	1	3	2	1	2	2	2
CO4	2	1	2	3	2	2	3
CO5	3	2	1	3	3	1	3
CO6	3	2	2	3	3	3	3

	PSO1	PSO2
CO1	-	1
CO2	1	2
CO3	2	1
CO4	-	2
CO5	2	2
CO6	1	3

Sign: Name: Smt. M.U.Kokate. Smt. H.F.Khan Smt. S.P.Ambavane Smt. K.S.Sathawane (Course Expert /s)	Sign: Name: Shri. U. V. Kokate Dr.S.B.Nikam (Head of Department) (Department of Computer Engineering)
Sign: Name: Shri. U. V. Kokate Dr.S.B.Nikam (Program Head) (Department of Computer Engineering)	Sign: Name: Shri A.S.Zanpure (CDC Incharge)

Government Polytechnic, Pune

‘180 OB’– Scheme

Programme	Diploma in Computer Engineering
Programme code	01/02/03/04/05/06/07/08/15/16/17/18/19/21/22/23/24/26
Name of Course	Data Mining
Course Code	CM5107
Prerequisite course code and name	NA
Class Declaration	Yes

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory		Practical		Total Marks
L	T	P	C	ESE	PA	SESE	PA	
03	00	02	05	Marks	80	20	25	25
				Exam Duration	3 Hrs	1 Hr		

Legends: L- Lecture, P- Practical, T- Tutorial, C- Credit, ESE-End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, \$- Oral Exam, #- Online Examination each Lecture/Practical period is of one clock hour

2. RATIONALE

Data mining is a process used by companies to turn raw data into useful information. By using software to look for patterns in large batches of data, businesses can learn more about their customers to develop more effective marketing strategies, increase sales and decrease costs. The objective of this course is to train students data mining and data warehousing concepts using open-source tools, languages and datasets.

3. COMPETENCY

The aim of this course is to attain the following competency through various teaching learning experiences.

- **Apply data pre-processing, data mining and warehousing concepts using open source tools/programming languages.**

4. COURSE OUTCOMES (COs):

1. Describe the concept of data mining & its attributes
2. Solve statistical data problems
3. Describe data pre-processing.
4. Apply various classification and clustering techniques.
5. Apply open source tools for various data mining techniques.
6. Describe data warehouse concepts.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1	1, 2	Make use of ARFF files taking input and display the output of the files.	1, 2	2
2	1, 2	Convert any excel file to .csv format and prepare it as ARFF files.	1, 2	2
3	3	Preprocess and classify any one dataset. (http://archive.ics.uci.edu/ml/)	3	2
4	3	Apply data cleansing on any two datasets. 1: http://archive.ics.uci.edu/ml/ 2: www.kdnuggets.com/datasets/)	3	4
5	4	Apply clustering techniques on any two datasets. (http://archive.ics.uci.edu/ml/)	4	4
6.	4	Classify any two datasets using decision tree. (www.kdnuggets.com/datasets/)	4	3
7.	5	Apply association technique on any two datasets. (1: http://archive.ics.uci.edu/ml/ , 2: www.kdnuggets.com/datasets/)	5	3
8	6	Install and use data mining tool	6	02
9				03
10		Practice various data mining techniques using open source tools.		03
11	ALL	Micro project: Refer Point 11 (Any One Micro project to be done)	ALL COs	04
Total Hrs				32

All above practicals are to be done on any open-source data mining tool / Programming languages (e. g. WEKA Tool/R Programming, Java, Python, etc)

S.No.	Performance Indicators	Weightage in %
1	Installation/configuration of data mining tool	30
2	Data Processing, Classification, Clustering, Association	40
3	Class to get desired output	10
4	Observations, Data Set Exploration and Recording	10
5	Answer to sample questions	10
Total		100

6. MAJOR EQUIPMENT/INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned.

Sr. No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	Open source data mining tools/Programming languages (e.g. WEKA tool, R Programming Environment, Python, Java, etc)	ALL
2	Open Source DATA SETS	ALL

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Section – I	
Unit-I Basics of Data Mining (Weightage-10, Hrs- 06)	
1a. Data Mining 1b. Kinds of data 1c. Kinds of patterns 1d. Cluster analysis 1.e Outlier analysis	1.1. What is data mining? 1.2 Kinds of Data 1.2.1 Database Data 1.2.2 Data Warehouses 1.2.3 Transactional Data 1.2.4 Other Kinds of Data 1.3 Kinds of patterns 1.3.1 Characterization and Discrimination 1.3.2. Mining frequent patterns, associations and correlations 1.3.3 Classification and regression analysis for predictive analysis 1.3.4 Cluster analysis 1.3.5 Outlier analysis
Unit-II Know Data Concepts (Weightage-10, Hrs- 06)	
2a. Mining techniques and Attribute Relation File Format (ARFF). 2b. Practice basic Statistical calculations on Data using WEKA.	2.1 Data Attributes 2.1.1 Nominal Attributes 2.1.2 Binary Attributes 2.1.3 Ordinal Attributes 2.1.4 Numeric Attributes 2.1.5 Discrete versus Continuous Attributes 2.2 Central Tendency- Mean, Median, and Mode 2.3 Dispersion: Range, Quartiles, Variance, Standard Deviation, and Interquartile Range.
Unit- III. Data Preprocessing (Weightage- 20, Hrs- 12)	
3a. Data preprocessing 3b. Data cleaning 3c. Data integration 3d. Data reduction	3.1 Need of preprocessing 3.2 Tasks in Data Preprocessing 3.3 Data Cleaning 3.3.1 Missing Values 3.3.2 Noisy Data 3.3.3 Data Cleaning as a Process 3.4 Data Integration 3.4.1 Entity Identification Problem 3.4.2 Redundancy and Correlation Analysis 3.4.3 Tuple Duplication 3.4.4 Data Value Conflict Detection and Resolution 3.5 Data Reduction 3.5.1 Wavelet Transforms 3.5.2 Principal Component Analysis 3.5.3 Attribute Subset Selection 3.5.4 Parametric data reduction 3.5.4 Histograms 3.5.5 Clustering

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Section II	
Unit-IV Classification (Weightage-20, Hrs- 12)	
4a. Describe various classification methods 4b. Describe clustering.	4.1 Basic Concepts 4.2 Decision tree induction 4.3 Bayes classification methods 4.4 Rule based classification 4.5 Classification by back propagation 4.6 Support vector machines 4.7 K- Nearest neighbor classifier 4.8 Genetic algorithms 4.9 Rough set approach 4.10 Fuzzy sets 4.11 Clustering: K means
Unit-V Open Source Data mining Tool (Weightage-05, Hrs- 3)	
5. Any data mining tool (e.g. WEKA tool)	5.1 Data mining tool introduction 5.2 Installation 5.3 Load data 5.4 File formats 5.5 Preprocessing data 5.6 Classifiers 5.7 Clustering 5.8 Association 5.9 Feature Selection
Unit-VI Data Warehousing (Weightage-15, Hrs- 9)	
6. Data Warehousing.	6.1 Basic concepts 6.2 Differences between Operational Database Systems and Data Warehouses 6.3 Datawarehouse: A Multitire architecture 6.4 Data warehouse models: Enterprise Warehouse, Data Mart, Virtual Warehouse

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
Section – I						
I	Basics of data mining	06	05	05	00	10
II	Know data concepts	06	02	02	06	10
III	Data Preprocessing	12	08	07	05	20
	Total	24	15	14	11	40
Section II						
IV	Classification	12	05	05	10	20
V	Open source data mining tool	03	00	01	04	05
VI	Data warehousing	09	08	06	01	15
	Total	24	13	12	15	40
	Grand Total	48	28	26	26	80

9 SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course. Students should conduct following activities in group and prepare reports of about 5 pages for each activity and, also collect/record physical evidences for their (students') portfolio which will be useful for their placement interviews:

- Search various datasets from Internet.
- Search various free software tools used for data mining and make practice of using them.
- Study R Programming language, Java, Python for applying to data mining concepts.

10 SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

- Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
- About **15-20% of the topics/sub-topics** which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the COs through classroom presentations (see implementation guideline for details).
- With respect to item No.8, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
- Guide student(s) in undertaking micro-projects.
- Use Flash/Animations to explain various components, operations
- Teacher should ask the students to go through instruction and Technical manuals

11 SUGGESTED MICRO-PROJECTS

- Create your own small dataset (e. g. image dataset)
- Create regression model in Python
- Create a clustering model in Python
- Use Python for classification (Decision tree classifier, K Nearest Neighbor (KNN) Classifier, Support Vector Machine (SVM) Classifier, etc)
- Apply R programming language for statistical computing and graphics.
- Apply Java for classification and clustering techniques.

12. SUGGESTED LEARNING RESOURCES

S. No.	Title	Author	Publisher, Edition, Year of publication, ISBN Number
1	Data Mining Concepts and Techniques	Jiawei Han and Micheline Kamber	Morgan Kaufmann, 3rd edition, 25 July 2011 <ul style="list-style-type: none"> • ISBN-10: 9780123814791 • ISBN-13: 978-9380931913
2	Data Mining Techniques	Arun K Pujari	Orient Longman Publishers, Second edition, 1 January 2010 <ul style="list-style-type: none"> • ISBN-10: 8173716722 • ISBN-13: 978-8173716720
3	Fundamentals of Data Warehouses	Jarke, M., Lenzerini, M., Vassiliou, Y., Vassiliadis, P.	Springer, 2nd, rev. and extended ed. 2003 edition (November 26, 2002) <ul style="list-style-type: none"> • ISBN-10 : 3540420894 • ISBN-13 : 978-3540420897
4	Principles of Data Mining	David Hand, Heikki Mannila, Padhraic Smyth.	PHI, 1st edition, (January 1, 2008) <ul style="list-style-type: none"> • ISBN-10 : 8120324579 • ISBN-13 : 978-8120324572

13. SOFTWARE/LEARNING WEBSITES

- 1) <https://www.solver.com/xlminer-data-mining>
- 2) <https://www.xlminer.com/>
- 3) https://www.tutorialspoint.com/weka/what_is_weka.html
- 4) <https://www.cs.waikato.ac.nz/ml/weka/>

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	2	2	-	-	2
CO2	3	-	2	2	-	-	2
CO3	3	3	2	2	-	-	2
CO4	1	-	-	3	-	-	2
CO5	3	2	2	2	1	-	3
CO6	1	2	2	2	1	-	3

	PSO1	PSO2
CO1	-	2
CO2	1	3
CO3	-	2
CO4	1	3
CO5	-	1
CO6	-	3

Sign: Name: 1. Shri. Dr. S. B. Nikam 2. Smt. N. R. Wagh 3. Smt.S.J.Siraskar (Course Experts)	Sign: Name: Shri. U. V .Kokate Dr.S.B.Nikam (Head of Department) (Department of Computer Engineering)
Sign: Name: Mr. U.V. Kokate Dr.S.B.Nikam (Programme Head) (Department of Computer Engineering)	Sign: Name: Mr. A.S. Zanpure (CDC In-charge)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diploma in Computer Engineering
Programme code	01/02/03/04/05/06/07/08/15/16/17/18/19/21/22/23/24/26
Name of Course	Cloud Computing
Course Code	CM5108
Prerequisite course code and name	NA
Class Declaration	Yes

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)				Total Credits (L+T+P)	Examination Scheme				Total Marks
L	T	P	C		Theory		Practical		
					ESE	PA	\$ESE	PA	150
				Marks	80	20	25	25	
03	00	02	05	Exam Duration	3 Hrs.	1 Hr.			

Legends: L- Lecture, P- Practical, T- Tutorial, C- Credit, ESE-End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, \$- Oral Exam, #- Online Examination each Lecture/Practical period is of one clock hour

2. RATIONALE

Cloud computing has evolved as a very important computing model, which enables information, software, and many other important resources to be provisioned over the network as services in an on-demand manner. This course covers various basic aspects of cloud computing such as cloud types, security in cloud, storage in cloud, cloud monitoring and management etc. This enables students to create and maintain cloud- based services which will also enable them to implement virtualization, and implement security in cloud services.

3. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Use Cloud computing to provide various services.

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

1. Describe the basic concepts of cloud computing
2. Classify various Cloud Service Models
3. Explain Cloud Service and resource management mechanisms
4. Illustrate Data Management in cloud
5. Demonstrate Cloud Security Measures
6. Compare and utilize various Open Source and Commercial Cloud.

5. SUGGESTED PRACTICALS/ EXERCISES

S. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approx. Hrs. Required
1	1	Study of any cloud architecture and it's service provider	1	02
2	1	Use Google Docs to make spreadsheets and notes	1	02
3	2	Study of Networking in Cloud: Virtual Private Cloud.	2	02
4	2	Case Study: PaaS (Facebook, Google App Engine)	2	04
5	3,4	Case Study: Cloud Monitoring and Management	3, 4	04
6	5	Study of Cloud Security such as Data Loss Prevention, Threat Detection etc.	5	04
7	6	Study of GCP Console: - Understanding Projects - Billing in GCP. - Install and configure Cloud SDK.	6	02
8	6	Study of GCP Console: Understanding Projects - Use Cloud Shell. - GCP APIs. - Cloud Console Mobile App	6	04
9	6	Study of GCP Console: Compute Engine - Running a basic Apache web server under GCP - Deploy basic App over the web server. - Host sample static website	6	04
10	All	Micro-project (Refer point 11 for micro project list)	All COs	04
Total Hrs				32

S. No.	Performance Indicators	Weightage in %
a	Configuration of cloud SDK	30
b	Use of different cloud services to solve given problem	40
c	Use security measure to secure the provided cloud service	10
d	Submit journal report in time	20
Total		100

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned.

Sr. No.	Major Equipment/ Instruments required	Experiment Sr. No.
1	Computer system (Any computer system with advanced configuration)	All
2	Internet connectivity (24 * 7)	

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Section I	
Unit - I Cloud Computing Fundamentals (Weightage-12, Hours-06)	
1a. Explain the properties and characteristics of Cloud Computing 1b. Explain various layers and types of Cloud 1c. Identify the challenges and risks related to various aspects such as Security and Privacy 1d. Explain the evolution of cloud computing and virtualization	1.1 Cloud Computing in a Nutshell 1.2 Roots of Cloud Computing: From Mainframes to Clouds, SOA, Web Services, Web 2.0, and Mashups, Grid Computing, Utility Computing, Hardware Virtualization, Virtual Appliances and the Open Virtualization Format, Autonomic Computing 1.3 Layers and Types of Clouds: Infrastructure as a Service, Platform as a Service, Software as a Service, Deployment Models 1.4 Properties and Characteristics of a Cloud computing 1.5 Challenges and Risks: Security, Privacy, and Trust, Data Lock-In and Standardization, Availability, Fault-Tolerance, and Disaster Recovery, Resource Management and Energy- Efficiency
Unit - II Cloud Architecture (Weightage-12, Hours - 08)	
2a. Explain the given component of cloud computing Architecture 2b. Compare various cloud computing model 2c. Illustrate the services offered by various cloud computing models 2d. Compare various Cloud deployment models	2.1 Cloud computing architecture: basic components – front-end platform, back-end platform, networking, cloud-based delivery 2.2 Cloud Infrastructure Management: Features, Cloud computing stack 2.3 Cloud Service Models: 2.3.1 Infrastructure as a Service (IaaS) 2.3.2 Platform as a Service (PaaS) 2.3.3 Software as a Service (SaaS) 2.4 Cloud Deployment Models: Public, Private, Community, Hybrid

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit - III Service Management and Resource Management in Cloud computing (Weightage-16, Hours - 10)	
3a. Outline Cloud Service Management procedure 3b. Explain Economics for Cloud Service Management 3c. Explain Policies and mechanisms for cloud resource management	3.1 Cloud Service Management 3.1.1 Service Level Objectives (SLO): Load balancing, Admission control 3.1.2 Service Level Agreement (SLA): Life-cycle of SLA, Types of SLA, SLA management in Cloud 3.1.3 Cloud economics 3.2 Cloud Resource management 3.2.1 Policies and mechanism for resource management: Admission control, capacity allocation, Load balancing, energy optimization, QoS (Quality of Service) guarantees
Section II	
Unit - IV Cloud Data Management (Weightage-14, Hours -08)	
4a. Outline Data Management in Cloud Computing 4b. Relate Database and Data Stores in Cloud 4c. Explain Large Scale Data Processing	4.1 Data Management in Cloud Computing: Introduction, Need of Data Management 4.2 Looking at Data, Scalability & Cloud Services 4.3 Database & Data Stores in Cloud 4.4 Large Scale Data Processing
Unit - V Cloud Security (Weightage-10, Hours -06)	
5a. Explain need of Cloud Security 5b. Compare various Cloud security Methods 5c. Interpret Access Management.	5.1 Need and importance of Cloud Security 5.2 Methods of Providing Cloud Security 5.3 Infrastructure Security: Methods, Case study 5.4 Data security and Storage: Methods, Case study 5.5 Identity and Access Management: Access Control, Trust, Reputation, Risk
Unit - VI Open Source and Commercial Clouds (Weightage-16, Hours -10)	
6a. Compare Open source and Commercial Cloud platforms 6b. Demonstrate various Open-Source Cloud Platforms 6c. Outline existing commercial cloud platforms. 6d. Illustrate Cloud Service Providers in Market	6.1 Open-source Vs Paid/ Commercial Cloud platforms 6.2 Introduction to Open-Source Clouds Platform: Characteristics, Existing Open-source cloud platforms 6.3 Introduction to Commercial Clouds Platforms: 6.3.1 Characteristics 6.3.2 Existing commercial cloud platforms: 6.4 Major Cloud Service Providers in Market: Google Cloud Platform (GCP), Amazon AWS, Microsoft Azure

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
Section - I						
I	Cloud Computing Fundamentals	06	06	06	00	12
II	Cloud Architecture	08	04	04	04	12
III	Service Management and Resource Management in Cloud computing	10	04	06	06	16
Total		24	14	16	10	40
Section - II						
IV	Cloud Data Management	08	04	06	04	14
V	Cloud Security	06	02	04	04	10
VI	Open Source and Commercial Clouds	10	04	06	06	16
Total		24	10	16	14	40
Grand Total		48	24	32	24	80

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

- a. Prepare journals based on practical performed in laboratory.
- b. Prepare report on suggestive case study of any cloud service for given Cloud Service Provider.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

- a. Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
- b. About *15-20% of the topics/sub-topics* which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the COs through classroom presentations.
- c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
- d. Use different Audio-Visual media for Concept understanding.
- e. Guide student(s) in undertaking micro-projects.
- f. Demonstrate students thoroughly before they start doing the practice.
- g. Observe continuously and monitor the performance of students in Lab.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should **not exceed three**. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. (Affective Domain Outcomes). Each student will have to maintain activity chart consisting of individual contribution in the project work and give a seminar presentation of it before submission. The student ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

- a. Discover Various Open Source and Commercial Cloud Platforms
- b. Distinguish and Determine Cloud Platform for given problem statement
- c. Create and Maintain Virtual Machines over Open-Source Cloud
- d. Choose cloud security measures to prevent data leak through SQL injection
- e. Make use of Cloud – Platform as Service to build a simple web application
- f. Deploy a simple web application over open-source cloud

12. SUGGESTED LEARNING RESOURCES

S. No.	Title	Author	Publisher, Edition, Year of publication, ISBN Number
1	Cloud computing principles and paradigms	Rajkumar Buyya	Wiley Publication, 1 st edition, 2013 • ISBN-10: 9788126541256 • ISBN-13: 978-8126541256
2	Enterprise Cloud Computing	Gautam Shroff	Cambridge Publication, 1 st edition, 2011 • ISBN-10: 1107648890 • ISBN-13: 978-1107648890
3	Cloud Computing	Dr. Kumar Saurabh	Wiley Publication, 2 nd Edition, 2012 • ISBN-10: 9788126536030 • ISBN-13: 978-8126536030

13. SOFTWARE/LEARNING WEBSITES

1. <https://www.nptel.ac.in>
2. <https://cloud.google.com/>
3. <https://aws.amazon.com/>
4. <https://www.ibm.com/cloud/case-studies/>
5. <https://www.cisco.com/c/en/us/solutions/cloud-computing/case-studies.html>
6. <https://microsoft.github.io/techcasestudies/>

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	-	-	-	-
CO2	2	2	1	1	-	1	-
CO3	2	3	2	2	1	1	-
CO4	2	2	2	2	1	2	-
CO5	2	3	2	3	1	2	1
CO6	2	3	3	3	-	3	1

	PSO1	PSO2
CO1	1	1
CO2	1	1
CO3	-	2
CO4	-	2
CO5	-	2
CO6	-	3

<p>Sign:</p> <p>Name: 1. Mrs. M.G. Yawalkar 2. Mrs. K.S. Sathawane (Course Experts)</p>	<p>Sign:</p> <p>Name: Mr. U.V. Kokate Dr. S.B.Nikam (Head of Department) (Department of Computer Engineering)</p>
<p>Sign:</p> <p>Name: Mr. U.V. Kokate Dr. S.B.Nikam (Programme Head) (Department of Computer Engineering)</p>	<p>Sign:</p> <p>Name: Mr. A.S. Zanpure (CDC In-charge)</p>

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diploma in Computer Engineering
Programme code	01/02/03/04/05/ 06 /07/08/16/17/21/22/23/24/ 26
Name of Course	Wireless Sensor Network
Course Code	CM5109
Prerequisite course code and name	NA
Class Declaration	Yes

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory		Practical		Total Marks
L	T	P	C	ESE	PA	SESE	PA	
03	00	02	05	Marks 80	20	25	25	
				Exam Duration 3 Hrs	1 Hr			

Legends: *L- Lecture, P- Practical, T- Tutorial, C- Credit, ESE-End Semester Examination, PA- Progressive Assessment (Test I, II/Term Work), *- Practical Exam, \$- Oral Exam, #- Online Examination each Lecture/Practical period is of one clock hour.*

2. RATIONALE

Nowadays, Wireless Sensor Networks (WSNs) emerge as an active research area in which challenging topics involve energy consumption, routing algorithms, selection of sensors location according to a given premise, robustness, efficiency, and so forth. Despite the open problems in WSNs, there are already a high number of applications available. In all cases for the design of any application, one of the main objectives is to keep the WSN alive and functional as long as possible. A key factor in this is the way the network is formed. The presents most recent formation techniques and mechanisms for the WSNs. The goal of this course is to give an overview of fundamental problems in the area of WSNs. We will discuss existing solutions for some of these problems. Data aggregation, information dissemination, security issues, power management, localization, topology control, routing, naming, collaborative signal and information processing for target tracking, security, are some of the topics that will be covered in this course.

3. COMPETENCY

The aim of this course is to help the students to attain the following competency through various teaching learning experiences.

- **To learn the basic principles behind a Wireless Sensor Network and able to specify the requirements for the hardware and software solutions for energy-efficient Sensor Network for new applications**

4. COURSE OUTCOMES (COs)

1. Describe various concepts and terminologies used in WSN.
2. Identify importance and use of radio communication and link management in WSN
3. Demonstrate various wireless standards and protocols associated with WSN.
4. Recognize importance of localization and routing techniques used in WSN.
5. Apply techniques of data aggregation and security in WSN.
6. Analyze the issues involved in design and deployment of WSN.

5. SUGGESTED PRACTICALS/ EXERCISES

Sr. No.	Unit No.	Practical Exercises	Relevant CO	Approximate Hours Required.
1	1	Study of various components of Sensor Node.	1	2
2	1	Study various Parameters of Sensor Node.	1	2
3	3	Design a network using source and sink node.	2	2
4	4	Routing Messages using Sensors.	3	4
5	1	Application of WSN in Hospital, Railway, Agriculture, Factory, City.	4	4
6	3	Basics of IOT Programming using the Arduino Platform.	5	4
7	6	Sensing data using the MKR1000 board.	5	4
8	6	Programming a MKR1000 board over the air in a standalone.	5	2
9	4,5	A] Collecting and exchanging data on WSN B] Sensing audio data and interpreting results	5,6	4
10	6	Micro-project (Refer point 11 for micro project list)	All COs	4
			Total	32

Sr.No.	Performance Indicators	Weightage in %
a.	Effective practical implementation within specific time	60
b.	Handling of WSN networking components	10
c.	Answer to questions	20
d.	Submission of assignment with in time	10
		Total
		100

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned.

Sr.No.	Major Equipment/ Instruments Required	Experiment Sr. No.
1	Sensor Nodes	All
2	Network Simulator	1 to 5
3	Arduino UNO Controller and Arduino Platform	6
4	MKR1000 board	7,8

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Section I	
Unit - I Fundamentals of Wireless Sensor Network (Weightage-14, Hrs-08)	
1a. List the benefits and applications of WSN. 1b. Understand Challenges of WSN. 1c. Select appropriate WSN architecture according to the requirements.	1.1 Fundamentals of WSN- What Are Wireless Sensor Networks, Challenges for Wireless Sensor Networks, Sensor Node, Anatomy of a Sensor Node. 1.2 Architecture of WSN: Single-Node Architecture - Hardware Components, 1.3 Performance metrics in WSN, types of WSN.
Unit - II Radio Communication & Link Management (Weightage- 14, Hrs-08)	
2a. Describe need of Radio Communication. 2b. Study properties of Wireless Communication. 3c. Differentiate between circuit switched and datagram network	2.1 Radio Waves and Modulation/ Demodulation. 2.2 Properties of Wireless Communications, Medium Access Protocols, Wireless Links Introduction. 2.3 Properties of Wireless Links, Error Control, Naming and Addressing, Topology Control.
Unit-III Wireless Standards & Protocol Stack (Weightage-12, Hrs-08)	
3a. Describe WSN IEEE Standards. 3b. Establish wireless LAN 3c. Create a Bluetooth enabled network.	3.1 WSN Standards- IEEE802.15.4 ISA 100.11a, 6LoWPAN, IEEE802.15.3. 3.2 Low rate WPAN, Zigbee, Wireless HART. 3.3 Wibree, BLE, Zwave, ANT, Insteon, 3.4 Wavenis, Protocol stack of WSNs, Cross Layer Protocol Stack.
Section II	
Unit-IV Localization & Routing (Weightage-14, Hrs-08)	
4a. Analyzing issues of Localization. 4b. Describe Routing issues.	4.1 Localization: Localization Challenges and Properties, Deployment Schemes, Proximity Schemes, Ranging Schemes. 4.2 Range-Based Localization, Range-Free Localization. 4.3 Routing Basics, Routing Metrics, Routing Protocols. 4.4 Full-Network Broadcast, Location-Based Routing, Directed Diffusion, Collection Tree Protocol, Zigbee, Multi-Hop Communications.

Unit-V Data Aggregation & Security (Weightage-14, Hrs-8)	
5a. Identify the protocols working in a layered architecture.	5.1 Clustering Techniques.
5b. Troubleshoot the network using standard network model.	5.2 In-Network Processing and Data Aggregation.
5c. Analysis of Security issues in WSN.	5.3 Compressive Sampling.
	5.4 Security Issues in Wireless Sensor Networks.
	5.5 Attacks, Defensive Measures,
	5.6 Security requirements and threat model.
Unit-VI Designing & Deploying WSN Applications (Weightage-12, Hrs-8)	
6a. Describe Design and Deploying issues of WSN.	6.1 Designing and Deploying WSN Applications.
6b. Demonstrate application of WSN	6.2 Early WSN Deployments.
6c. Analyze WSN Analysis	6.3 General Problems, General Testing and Validation, Requirements Analysis.
	6.4 Top-Down Design Process, Bottom-Up Implementation Process.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
Section-I						
I	Fundamentals of Wireless Sensor Network	08	6	4	4	14
II	Radio Communication & Link Management	08	4	6	4	14
III	Wireless Standards & Protocol Stack	08	4	6	2	12
Total		24	14	16	10	40
Section -II						
IV	Localization & Routing	08	4	6	4	14
V	Data Aggregation & Security	08	6	6	2	14
VI	Designing & Deploying WSN Applications	08	4	6	2	12
Total		24	14	18	8	40
Grand Total		48	28	34	18	80

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

- Identify need of Wireless Sensor Network in your Department.
- Analysis of Various Components of Wireless Sensor Network.
- Analysis of Limitation of Wireless Sensor Network.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

- a. Demonstration of Wireless Sensor Network installation in the institute and its technology. Give an environment to establish, configure and troubleshoot a small network by giving hands on practice.
- b. Massive open online courses (MOOCs) can be used to teach various topics.

11 SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should **not exceed three**. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. (Affective Domain Outcomes). Each student will have to maintain activity chart consisting of individual contribution in the project work and give a seminar presentation of it before submission. The student ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty

- a. Automated Street Light System.
- b. Weather Forecasting System.
- c. Automated Traffic Control System.

12 SUGGESTED LEARNING RESOURCES

S.N O.	Title	Author,	Publisher, Edition and Year of publication ISBN Number
1	Wireless Sensor Networks	Kazem Sohraby	Daniel Minoli, & Taieb Znati, John Wiley, 2007 • ISBN-10 0471743003
2	Wireless Sensor Networks	Zhao Feng, Elsevier India	Morgan Kaufmann, First Edition 6th July 2004 • ISBN-10 9781558609143
3	Building Wireless Sensor Networks	Robert Faludi	O'Reilly Media, Inc., December 2010 • ISBN-10 978-0596807733

13 SOFTWARE/LEARNING WEBSITES

1. www.nptel.ac.in
2. www.tutorialspoint.com

14 PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	2	2	1	-	-	1
CO2	1	2	2	2	-	-	1
CO3	1	2	2	2	1	1	1
CO4	1	1	3	2	1	1	1
CO5	1	1	3	2	1	1	1
CO6	1	1	2	2	1	1	1

	PSO1	PSO2
CO1	1	1
CO2	1	1
CO3	1	2
CO4	1	2
CO5	1	1
CO6	1	1

<p>Sign:</p> <p>Name:</p> <p>1. Smt.A.A.Shaikh 2. .Smt.N.R.Wagh 3. Smt.S.J.Siraskar (Course Experts)</p>	<p>Sign:</p> <p>Name:</p> <p>Mr. U.V. Kokate Dr. S.B. Nikam (Head of Department) (Department of Computer Engineering)</p>
<p>Sign:</p> <p>Name:</p> <p>Mr. U.V. Kokate Dr. S.B.Nikam (Programme Head) (Department of Computer Engineering)</p>	<p>Sign:</p> <p>Name:</p> <p>Mr. A.S. Zanpure (CDC In-charge)</p>