SGT University, Chandu-Budhera, Gurugram
Faculty of Engineering & Technology
Department of Computer Science & Engineering

M. Tech. Computer Science & Engineering
Scheme & Syllabus (2020-21)

Vision of SGT University

"Driven by Research & Innovation, we aspire to be amongst the top ten Universities in the Country by 2022"

Semester I

S. NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Ext.	Int.	
1	13070101	Advance Software Engineering	3	0	0	3	60	40	100
2	13070102	Research Methodology& IPR	3	0	0	3	60	40	100
3	13070103	Computer Vision	3	0	0	3	60	40	100
4	13070104	Cryptography & Network Security	3	0	0	3	60	40	100
5	13070105	Research Methodology & IPR Lab	0	0	2	1	40	60	100
6	13070106	Cryptography & Network Security Lab	0	0	2	1	40	60	100
7	13070107	Seminar	0	0	2	1		100	100
		Total	**12**	**0**	**6**	**15**	**320**	**380**	**700**

Semester II

S. NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Ext.	Int.	
1	13070201	Soft Computing	3	0	0	3	60	40	100
2	13070202	Digital Image Processing	3	0	0	3	60	40	100
3	13070203	Advanced DBMS	3	0	0	3	60	40	100
4		**Program Elective – I**	3	0	0	3	60	40	100
5	13070209	Digital Image Processing Lab	0	0	2	1	40	60	100
6	13070210	Advanced DBMS Lab	0	0	2	1	40	60	100
7	13070211	Seminar	0	0	2	1		100	100
		Total	**12**	0	**6**	**15**	**320**	**380**	**700**

Semester III

S.NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Ext.	Int.	
1	13070301	Artificial Intelligence	3	0	0	3	60	40	100
2	13070302	Data Mining	3	0	0	3	60	40	100
3	13070303	Cloud Computing	3	0	0	3	60	40	100
4		**Program Elective – II**	3	0	0	3	60	40	100
5	13070309	Artificial Intelligence Lab	0	0	2	1	40	60	100
6	13070310	Capstone Project/Research based Project	0	0	2	1	40	60	100
7	13070311	Identification of Research Problem	0	0	2	0			
		Total	**12**	**0**	**6**	**14**	**320**	**280**	**600**

Semester IV

S.NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Ext.	Int.	
1	13070401	Dissertation	0	0	20w	20	100	100	200
		Total	**0**	**0**	**20w**	**20**	**100**	**100**	**200**

List of Program Electives

S. No.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Ext.	Int.	
Elective I									
1	13070204	Software Verification Validation & Testing	3	0	0	3	60	40	100
2	13070205	Neural Network	3	0	0	3	60	40	100
3	13070206	Ethical Hacking	3	0	0	3	60	40	100
4	13070207	Data Science	3	0	0	3	60	40	100
5	13070208	Virtual Reality	3	0	0	3	60	40	100
Elective II									
1	13070304	Software Project Management	3	0	0	3	60	40	100
2	13070305	Deep Learning	3	0	0	3	60	40	100
3	13070306	Information & Security Management	3	0	0	3	60	40	100
4	13070307	Big Data & Hadoop	3	0	0	3	60	40	100
5	13070308	Augmented Reality	3	0	0	3	60	40	100
		(*Students to opt for any 2 subjects as per scheme*)							

Total credits: 64 credits

Semester I

Advanced Software Engineering & Testing

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td colspan="2">2. Course Name</td><td>Advanced Software Engineering & Testing</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td colspan="2">3. Course Code</td><td>13070101</td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core (✔)</td><td colspan="2">PE()</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td>Computer Fundamental</td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✔)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td colspan="2">Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="8">8. Course Description</td></tr>
<tr><td colspan="8">This course aims to equip students to develop techniques of software-intensive systems through successful requirements engineering, design, testing, maintenance and evolution, and project and quality management. Students build on their basic software engineering knowledge by extending it with specific techniques for maintenance, evolution, dependability, reliability, safety, security, and resilience.</td></tr>
<tr><td colspan="8">9. Learning objectives:
• To Know the Basics of Software Architecture
• To Understand various phases of Software Development Cycle
• Sufficient programming skills for the team development project.
• Appreciate the fundamentals of software testing and its application through the software life cycle.</td></tr>
<tr><td colspan="8">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="8">• Develop skills in designing and executing software tests suitable for different stages in the software life cycle.</td></tr>
<tr><td colspan="8">• Understand and appreciate the role of software testing in systems development, deployment and maintenance.</td></tr>
<tr><td colspan="8">• Develop a continuing interest in software testing, and obtain satisfaction from its study and practice.</td></tr>
<tr><td colspan="8">• Appreciate the responsibilities of software testers within software projects, the profession and the wider community.</td></tr>
<tr><td colspan="8">11. Unit wise detailed content</td></tr>
<tr><td colspan="2">Unit-1</td><td>Number of lectures = 09</td><td colspan="5"></td></tr>
<tr><td colspan="8">Introduction: Programs vs. software products, emergence of software engineering, software life cycle, models. Software project management: Project management concepts, software process, Project planning, COCOMO Model A Heuristic estimation techniques, staffing level estimation, team structures, staffing, risk analysis and management. Requirement Analysis and specification: Requirements engineering, partitioning Software, prototyping</td></tr>
</table>

Unit – 2	Number of lectures = 08	
Data Modeling, Functional Modeling and information flow: Data flow diagrams, data flow model, control flow model, the control and process specification, The data dictionary, Other classical analysis methods. System Design design principles, Functional independence, Cohesion, Coupling, Design documentation.		
Unit – 3	**Number of lectures = 09**	
Testing and maintenance: Software Testing Techniques, Software testing Fundamentals, Verification Testing: Verification Methods, SRS Verification, User Documentation Verification, Functional Testing: Boundary Value Analysis, Equivalence Class Testing, Structural Testing: Identification of Independent Paths: Control Flow Graph. Use Case Testing: Use Case Diagrams and Use Cases. Prioritization of test cases for Regression Testing: Regression Testing, Regression Test Case Selection, Prioritization guidelines.		
Unit – 4	**Number of lectures = 10**	
Testing Activities: Unit Testing, Levels of Testing, Integration Testing, System Testing, Metrics and Models in Software Testing: What are Software Metrics, categories of Metrics, object Oriented Metrics used in testing, What should we measure during testing? Prediction Model: Reliability Modes, Fault Prediction Model.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Software Engineering - A Practitioner‟s Approach, Roger S. Pressman, MGH Publications, New Delhi, Eighth edition, 2019.
- Effective Methods for Software Testing, William Perry, John Wiley & Sons, New York, Van Nostrand Reinhold, New York, 2nd Ed., 2006.

Reference Books

- An Integrated Approach to Software Engineering by Pankaj Jalote, Narosa Publications, New Delhi, 2010.
- Fundamentals of Software Engineering, Rajib Mall, PHI Learning; Fifth edition, 2019.
- Software Testing A Craftsman‟s approach, Paul C. Jorgenson, CRC Press.
- Testing Computer Software, Cem Kaner, Jack Falk, Nguyen Quoc, Van Nostrand Reinhold, New York, 2nd Ed.

Semester I

Research Methodology and IPR

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td colspan="2">2. Course Name</td><td colspan="2">Research Methodology and IPR</td><td>L</td><td>T</td><td colspan="2">P</td></tr>
<tr><td colspan="2">3. Course Code</td><td colspan="2">13070102</td><td>3</td><td>0</td><td colspan="2">0</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td>Core (✔)</td><td>PE()</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td>None</td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✔)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="8">8. Course Description
This course is designed to help students to identify research problems in various fields. It aims at giving potential researchers the knowledge of effectively analyzing and interpreting results and presenting the findings to the scientific and technological community of the world. This course also aims at motivating students to bring about their creative ideas for innovation and establishing research impact in the global foray through intellectual ownership</td></tr>
<tr><td colspan="8">9. Learning objectives:
• The course has been developed with orientation towards research related activities and recognizing the ensuing knowledge as property.
• It will create consciousness for Intellectual Property Rights and its constituents.
• Learners will be able to perform documentation and administrative procedures relating to IPR in India as well as abroad.</td></tr>
<tr><td colspan="8">10. Course Outcomes (COs): At the end of this course, students will be able to
• Understand research problem formulation.
• Analyze research related information
• Follow research ethics
• Understand that today’s world is controlled by Computer, Information
• Technology, but tomorrow world will be ruled by ideas, concept, and creativity. Understanding that when IPR would take such important place in growth of
• Individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular. Understand that IPR protection provides an incentive to inventors for further
• Research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits</td></tr>
<tr><td colspan="8">11. Unit wise detailed content</td></tr>
<tr><td colspan="2">Unit-1</td><td colspan="2">Number of lectures = 10</td><td colspan="4">Introduction</td></tr>
<tr><td colspan="8">Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations, Effective literature studies approaches, analysis Plagiarism, Research ethics</td></tr>
</table>

Unit – 2	**Number of lectures = 08**	**Research Writing**
Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee		
Unit – 3	**Number of lectures = 10**	**IPR**
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT. Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.		
Unit – 4	**Number of lectures = 08**	**IPR today**
New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
- Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.

Reference Books

- Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
- Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
- Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
- Mayall, "Industrial Design", McGraw Hill, 1992.
- Niebel, "Product Design", McGraw Hill, 1974.
- Asimov, "Introduction to Design", Prentice Hall, 1962.
- T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Semester I

Research Methodology and IPR Lab

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td colspan="2">2. Course Name</td><td colspan="2">Research Methodology and IPR Lab</td><td>L</td><td>T</td><td colspan="2">P</td></tr>
<tr><td colspan="2">3. Course Code</td><td colspan="2">13070105</td><td>0</td><td>0</td><td colspan="2">2</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td>Core (✔)</td><td colspan="2">PE()</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td>English as language</td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✔)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 0</td><td>Tutorials = 0</td><td colspan="4">Practical = 24</td></tr>
</table>

8. Course Description

This course focuses on the composition of research papers as well as critical textual analysis and synthesis in academic discourse. Students will receive instruction and practice in conceiving, drafting, revising and completing papers based upon sources that challenge them to seek new information and to reflect upon its relevance to their own observations and experience. This course provides students with a variety of research and writing skills. Activities include writing assignments, readings on composition techniques, readings of literature and criticism, online discussions, and lessons on relevant grammar issues and formatting sound arguments.

9. Learning objectives: Students will be able to:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

10. Course Outcomes (COs):

In this course, students can expect to do the following:

1. Adapt rhetorical processes and strategies for audience, purpose and type of task
2. Organize and produce texts that meet the demands of specific genres, purposes, audiences and stances
3. Employ appropriate mechanics, usage, grammar and spelling conventions
4. Find, analyze, evaluate, summarize and synthesize appropriate source material from both print and electronic environments
5. Present focused, logical arguments that support a thesis
6. Use reliable and varied evidence to support claims, incorporate ideas from sources appropriately, and acknowledge and document the work of others appropriately
7. Use electronic environments to draft, revise, edit and share or publish texts

11. List of Experiments

1) Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness
2) Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction
3) Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.
4) Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature
5) Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions
6) Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

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Semester I

Computer Vision

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td colspan="2">2. Course Name</td><td>Computer Vision</td><td colspan="2">L</td><td colspan="2">T</td><td>P</td></tr>
<tr><td colspan="2">3. Course Code</td><td>13070103</td><td colspan="2">3</td><td colspan="2">0</td><td>0</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td colspan="2">Core (✔)</td><td colspan="2">PE()</td><td>OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td>Basic Mathematics knowledge</td><td>Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✔)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">6. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 36</td><td colspan="2">Tutorials = 0</td><td colspan="3">Practical = 0</td></tr>
<tr><td colspan="8">7. Course Description</td></tr>
<tr><td colspan="8">The aim of this course is to motivate the students to explore about visible world around us.</td></tr>
<tr><td colspan="8">8. Learning objectives:
• Computer Vision focuses on development of algorithms and techniques to analyze and interpret the visible world around us.</td></tr>
<tr><td colspan="8">9. Course Outcomes (COs):</td></tr>
<tr><td colspan="8">• Upon the completion of this course, the student will be able to:</td></tr>
<tr><td colspan="8">• Understanding of the fundamental concepts related to multi-dimensional signal processing, feature extraction, pattern analysis visual geometric modeling, stochastic optimization etc.</td></tr>
<tr><td colspan="8">10. Unit wise detailed content</td></tr>
<tr><td colspan="2">Unit-1</td><td>Number of lectures = 10</td><td colspan="5">Digital Image formation & Depth estimation</td></tr>
<tr><td colspan="8">Digital Image Formation and low-level processing: Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc; Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.

Depth estimation and Multi-camera views: Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration</td></tr>
<tr><td colspan="2">Unit – 2</td><td>Number of lectures = 08</td><td colspan="5">Random Feature Extraction</td></tr>
<tr><td colspan="8">Random Feature Extraction: Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.</td></tr>
<tr><td colspan="2">Unit – 3</td><td>Number of lectures = 10</td><td colspan="5">Image segmentation & Pattern Analysis</td></tr>
<tr><td colspan="8">Image Segmentation: Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-</td></tr>
</table>

Shift, MRFs, Texture Segmentation; Object detection.

Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods..

Unit – 4	**Number of lectures = 08**	**Motion Analysis & Shape from X**

Motion Analysis: Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation.

Shape from X: Light at Surfaces; Phong Model; Reflectance Map; Albedo estimation; Photometric Stereo; Use of Surface Smoothness Constraint; Shape from Texture, color, motion and edges.

11. Brief Description of self-learning / E-learning component

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The link to the E-Learning portal.

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12. Books Recommended

Text Books

- Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.

Reference Books

- Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2003.
- Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
- K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.

Semester I

Cryptography & Network Security

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td colspan="2">2. Course Name</td><td>Cryptography & Network Security</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td colspan="2">3. Course Code</td><td>13070104</td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td>Core (✔)</td><td colspan="2">PE()</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td>Linear Algebra</td><td>Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✔)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">6. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="8">7. Course Description</td></tr>
<tr><td colspan="8">The aim of this course is to motivate the students an intrinsic interest in cryptography and network security.</td></tr>
<tr><td colspan="8">8. Learning objectives:
To lay a foundation on Security in Networks, attacks, defense and Classical Cryptosystems
To analyze various Private and Public Key Cryptosystems to ensure confidentiality, Integrity and Authentication.
To analyze various protocols to ensure Email Security and Network Security.
To apply Cryptography in various Applications.</td></tr>
<tr><td colspan="8">9. Course Outcomes (COs):</td></tr>
<tr><td colspan="8">Understand the fundamental concepts of Cryptography, Types of Security breaches, attacks, defense, control measures, Classical Cryptosystem.</td></tr>
<tr><td colspan="8">Compare various Private and Public key Cryptosystems to ensure confidentiality, Integrity and Authentication.</td></tr>
<tr><td colspan="8">Understand various protocols in Email Security and Network Security.</td></tr>
<tr><td colspan="8">Apply Cryptography in various Applications.</td></tr>
<tr><td colspan="8">10. Unit wise detailed content</td></tr>
<tr><td colspan="2">Unit-1</td><td>Number of lectures = 10</td><td colspan="5">Introduction</td></tr>
<tr><td colspan="8">Introduction to Security in networks, Types of Security breaches, attacks, defence, control measures, Classifying cryptosystems, classical cryptosystems, block cipher modes of operation, DES encryption and decryption, triple DES, AES encryption and decryption.</td></tr>
<tr><td colspan="2">Unit – 2</td><td>Number of lectures = 10</td><td colspan="5">Public Key Cryptosystem</td></tr>
<tr><td colspan="8">Public Key Cryptosystem - RSA cryptosystem, Diffie-Hellman Key Exchange Algorithm, Elliptic curve cryptosystem, Message Authentication and Hash Function- MD5 message digest algorithm,</td></tr>
</table>

Secure hash algorithm, Authentication Protocols and Digital signature, DSS.		
Unit – 3	**Number of lectures = 10**	**Security protocols**
Kerberos - X.509 Authentication Service. – Pretty Good Privacy - Electronic Mail Security – IP Security Architecture – Web Security Considerations – Secure Socket Layer and Transport Layer Security – Secure Electronic Transaction –Firewalls – Firewall Design Principles		
Unit – 4	**Number of lectures = 06**	**Application of Cryptography**
Applications of Cryptography- Blockchain, Bitcoin and Cryptocurrency Technologies		

11. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

12. Books Recommended

Text Books

- Stallings W., Cryptography and Network security: Principles and Practice, 7/e, Pearson Education Asia, 2017.

Reference Books

- Behrouz A. Forouzan, Debdeep Mukhopadhyay, Cryptography and Network Security, 3rd Edition, Mc Graw Hill Education, 2016.
- Charles P. Pleeger, Shari Lawrence Pfleeger, “Security in Computing”, Pearson Education Asia, 4th Edition, 2009.
- Kahate Atul, “Cryptography & Network Security”, Tata McGraw Hills, Eigth Reprint, 2006.

Semester I

Cryptography & Network Security Lab

<table>
<tr><td colspan="8">13. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>14. Course Name</td><td colspan="2">Cryptography & Network Security Lab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>15. Course Code</td><td colspan="2">13070106</td><td>0</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="2">16. Type of Course (use tick mark)</td><td>Core (✔)</td><td colspan="2">PE()</td><td colspan="2">OE ()</td></tr>
<tr><td>17. Pre-requisite (if any)</td><td colspan="2">Linear Algebra</td><td>Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✔)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">18. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 0</td><td>Tutorials = 0</td><td colspan="4">Practical = 24</td></tr>
<tr><td colspan="8">19. Course Description</td></tr>
<tr><td colspan="8">The aim of this course is to motivate the students an intrinsic interest in cryptography and network security.</td></tr>
<tr><td colspan="8">20. Learning objectives:
To lay a foundation on Security in Networks, attacks, defense and Classical Cryptosystems
To analyze various Private and Public Key Cryptosystems to ensure confidentiality, Integrity and Authentication.
To analyze various protocols to ensure Email Security and Network Security.
To apply Cryptography in various Applications.</td></tr>
<tr><td colspan="8">21. Course Outcomes (COs):</td></tr>
<tr><td colspan="8">Understand the fundamental concepts of Cryptography, Types of Security breaches, attacks, defense, control measures, Classical Cryptosystem.</td></tr>
<tr><td colspan="8">Compare various Private and Public key Cryptosystems to ensure confidentiality, Integrity and Authentication.</td></tr>
<tr><td colspan="8">Understand various protocols in Email Security and Network Security.</td></tr>
<tr><td colspan="8">Apply Cryptography in various Applications.</td></tr>
<tr><td colspan="8">22. Unit wise detailed content</td></tr>
<tr><td colspan="8">23. List of Experiments</td></tr>
<tr><td colspan="8">1) WAP to generate the prime number using Rabin-Miller Test.
2) Write a program to perform encryption and decryption
3) using the following algorithms:
a) Ceaser Cipher
b) Substitution Cipher
c) Hill Cipher
4) Write a program to implement the DES algorithm logic.
5) Write a program to implement the BlowFish algorithm Logic.
6) Write a program to implement the Rijndael algorithm logic.
7) Write a program to implement RSA Algoithm.
8) Implement the Diffie-Hellman Key Exchange mechanism using HTML and JavaScript. Consider the end user as one of the parties (Alice) and the JavaScript application as other party (bob).
9) Calculate the message digest of a text using the SHA-3 algorithm in JAVA.</td></tr>
</table>

At the end of course student will be able to do project on:

a) AES Encryption for Shell Scripts
b) Encryption of text in files while saving on hard disk.
c) Implementation Diffie-Hellmann Key Exchange with OpenSSL
d) Implementation of File to Image Encryption

At least one Project is mandatory for each student. Project can be done in a group of (2-3) students

24. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

Semester II

Soft Computing

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td colspan="2">2. Course Name</td><td colspan="2">Soft Computing</td><td colspan="2">L</td><td colspan="2">T</td><td>P</td></tr>
<tr><td colspan="2">3. Course Code</td><td colspan="2">13070201</td><td colspan="2">3</td><td colspan="2">0</td><td>0</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td colspan="2">Core (✔)</td><td colspan="2">PE()</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td>C, Discrete maths</td><td colspan="2">6. Frequency (use tick marks)</td><td>Even (✔)</td><td>Odd ()</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="9">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 36</td><td colspan="3">Tutorials = 0</td><td colspan="3">Practical = 0</td></tr>
<tr><td colspan="9">8. Course Description</td></tr>
<tr><td colspan="9">The purpose of this course is to provide concept of soft computing.</td></tr>
<tr><td colspan="9">9. Learning objectives:
1. Introduce students to soft computing concepts and techniques and foster their abilities in designing and implementing soft computing-based solutions for real-world and engineering problems.
2. Introduce students to fuzzy systems, fuzzy logic and its applications.
3. Explain the students about Artificial Neural Networks and various categories of ANN.</td></tr>
<tr><td colspan="9">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="9">• After learning the course the students should be able to:</td></tr>
<tr><td colspan="9">• Identify and describe soft computing techniques and their roles in building intelligent machines</td></tr>
<tr><td colspan="9">• Recognize the feasibility of applying a soft computing methodology for a particular problem</td></tr>
<tr><td colspan="9">• Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems</td></tr>
<tr><td colspan="9">11. Unit wise detailed content</td></tr>
<tr><td colspan="2">Unit-1</td><td colspan="2">Number of lectures = 09</td><td colspan="5">Neural Networks:</td></tr>
<tr><td colspan="9">History, overview of biological Neuro - system, Mathematical Models of Neurons, ANN architecture, Learning rules, Learning Paradigms-Supervised, Unsupervised and reinforcement Learning ANN training Algorithms-perceptions, Training rules, Delta, Back Propagation Algorithm, Multilayer Perception Model, Hopfield Networks, Associative Memories, Applications of Artificial Neural Networks.</td></tr>
<tr><td colspan="2">Unit – 2</td><td colspan="2">Number of lectures = 09</td><td colspan="5">Fuzzy Logic:</td></tr>
<tr><td colspan="9">Introduction to Fuzzy Logic, Classical and Fuzzy Sets: Overview of Classical Sets, Membership Function; Fuzzy rule generation.
Operations on Fuzzy Sets : Compliment, Intersections, Unions, Combinations of Operations, Aggregation Operations</td></tr>
<tr><td colspan="2">Unit – 3</td><td colspan="2">Number of lectures = 09</td><td colspan="5">Fuzzy Arithmetic:</td></tr>
<tr><td colspan="9">Fuzzy Numbers, Linguistic Variables, Arithmetic Operations on Intervals & Numbers, Lattice of Fuzzy Numbers, Fuzzy Equations.
Classical Logic, Multi-valued Logics, Fuzzy Propositions, Fuzzy Qualifiers, Linguistic Hedges.</td></tr>
</table>

Unit – 4	Number of lectures = 09	Uncertainty based Information:
Information & Uncertainty, Non specificity of fuzzy & Crisp sets, Fuzziness of Fuzzy Sets.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, S.Rajasekaran, G. A. Vijayalakshami, PHI.

Reference Books

- Genetic Algorithms: Search and Optimization, E. Goldberg.
- Neuro-Fuzzy Systems, Chin Teng Lin, C. S. George Lee, PHI.
- Build_Neural_Network_With_MS_Excel_sample by Joe choong.

Semester II

Digital Image Processing

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td colspan="2">2. Course Name</td><td colspan="2">Digital Image Processing</td><td colspan="2">L</td><td colspan="2">T</td><td>P</td></tr>
<tr><td colspan="2">3. Course Code</td><td colspan="2">13070202</td><td colspan="2">3</td><td colspan="2">0</td><td>0</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td colspan="2">Core (✔)</td><td colspan="2">PE()</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td>Basic Maths</td><td colspan="2">6. Frequency (use tick marks)</td><td>Even (✔)</td><td>Odd ()</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="9">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 36</td><td colspan="3">Tutorials = 0</td><td colspan="3">Practical = 0</td></tr>
<tr><td colspan="9">8. Course Description</td></tr>
<tr><td colspan="9">The purpose of this course is to provide basic concepts of data image processing.</td></tr>
<tr><td colspan="9">9. Learning objectives:
• learn different techniques employed for the enhancement of images.
• learn different causes for image degradation and overview of image restoration techniques.
• learn different feature extraction techniques for image analysis and recognition</td></tr>
<tr><td colspan="9">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="9">• To study the image fundamentals and mathematical transforms necessary for image processing.</td></tr>
<tr><td colspan="9">• To study the image enhancement techniques</td></tr>
<tr><td colspan="9">• To study image restoration procedures.</td></tr>
<tr><td colspan="9">• To study the image compression procedures</td></tr>
<tr><td colspan="9">11. Unit wise detailed content</td></tr>
<tr><td colspan="2">Unit-1</td><td colspan="2">Number of lectures = 09</td><td colspan="5">Introduction to Digital Image</td></tr>
<tr><td colspan="9">Introduction and Digital Image Fundamentals: The origins of Digital Image Processing, Fundamentals Steps in Image Processing, Elements of Digital Image Processing Systems, Image Sampling and Quantization, Some basic relationships like Neighbours, Connectivity, Distance Measures between pixels, Linear and Non Linear Operations. Image Enhancement: Point Operations, Histograms, Spatial Domain methods, Frequency domain methods.</td></tr>
<tr><td colspan="2">Unit – 2</td><td colspan="2">Number of lectures = 09</td><td colspan="5">Image Restoration & . Image Compression</td></tr>
<tr><td colspan="9">Image Restoration Degradation Model, Algebraic approach to Restoration, Inverse Filtering, Wiener Filter, Constrained least square restoration, Interactive restoration, Restoration in spatial domain. Image Compression: Coding, Interpixel and Psychovisual Redundancy, Image Compression Models, Elements of Information Theory, Error free comparison Lossy Compression, Image Compression Standards.</td></tr>
<tr><td colspan="2">Unit – 3</td><td colspan="2">Number of</td><td colspan="5">Image Segmentation</td></tr>
</table>

	lectures = 09	
Image Segmentation: Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region Oriented Segmentation, Motion based segmentation. Representation and Description: Representation, Boundary Descriptors, Regional Descriptors, Use of Principal Components for Description, Introduction to Morphology, Some basic Morphological Algorithms		
Unit – 4	**Number of lectures = 09**	**Object Recognition**
Object Recognition: Patterns and Pattern Classes, Decision–Theoretic Methods, Structural Methods.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Rafael C. Gonzalez & Richard E. Woods, "Digital Image Processing", 2nd Edition

Reference Books

- A.K. Jain, "Fundamental of Digital Image Processing", PHI

Semester II

Data Image processing Lab

<table>
<tr><td colspan="2">1. Course Name</td><td>Data Image processing Lab</td><td colspan="2">L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td colspan="2">2. Course Code</td><td>13070209</td><td colspan="2">0</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="3">3. Type of Course (use tick mark)</td><td colspan="2">Core (✔)</td><td colspan="2">PE( )</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="2">4. Pre-requisite (if any)</td><td></td><td colspan="2">5. Frequency (use tick marks)</td><td>Even</td><td>Odd (✔)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="9">6. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 0</td><td colspan="3">Tutorials = 0</td><td colspan="3">Practical = 24</td></tr>
<tr><td colspan="9">7. Course Description: The purpose of this course is to provide basic concepts of data image processing.</td></tr>
<tr><td colspan="9">14. Learning objectives:
• learn different techniques employed for the enhancement of images.
• learn different causes for image degradation and overview of image restoration techniques.
• learn different feature extraction techniques for image analysis and recognition</td></tr>
<tr><td colspan="9">8. Course Outcomes (COs):</td></tr>
<tr><td colspan="9">• To study the image fundamentals and mathematical transforms necessary for image processing.</td></tr>
<tr><td colspan="9">• To study the image enhancement techniques</td></tr>
<tr><td colspan="9">• To study the image compression procedures</td></tr>
<tr><td colspan="9">• To study the image fundamentals and mathematical transforms necessary for image processing.</td></tr>
<tr><td colspan="9">9. List of Experiments</td></tr>
<tr><td colspan="9">1. Implement the basic commands/ functions of an image processing tool.
2. Take an input image and plot its histogram with various ways as imhist, bar, stem, plot and prove that histogram processing can be used for image enhancement.
3. Filtering using MATLAB package
4. Filtering for Blurring and Sharpening the image
5. Implement various Nonlinear Spatial Filters.
6. Implement various types of filters to remove the noise in an image.
7. Implement image compression algorithms.
8. Design problems related to image segmentation
9. Design problems related to image recognition, pattern recognition</td></tr>
<tr><td colspan="9">10. Brief Description of self-learning / E-learning component

https://www.mathworks.com/products/image.html</td></tr>
</table>

Semester II

Advanced Database Management System

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td colspan="2">2. Course Name</td><td colspan="2">Advanced Database management System</td><td colspan="2">L</td><td colspan="2">T</td><td>P</td></tr>
<tr><td colspan="2">3. Course Code</td><td colspan="2">13070203</td><td colspan="2">3</td><td colspan="2">0</td><td>0</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td colspan="2">Core (✔)</td><td colspan="2">PE()</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="2">5. Prerequisite (if any)</td><td>DBMS</td><td colspan="2">6. Frequency (use tick marks)</td><td>Even (✔)</td><td>Odd ()</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="9">7. Total Number of Lectures, Tutorials, Practical (assuming 12weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 36</td><td colspan="3">Tutorials = 0</td><td colspan="3">Practical = 0</td></tr>
<tr><td colspan="9">8. Course Description</td></tr>
<tr><td colspan="9">This module aims to give students in depth information about system implementation techniques, data storage, representing data elements, database system architecture, the system catalog, query processing and optimization, transaction processing concepts, concurrency control techniques, database recovery techniques.</td></tr>
<tr><td colspan="9">9. Learning objectives:
• To understand the basic concepts and terminology related to DBMS and Relational Database Design
• To the design and implement Distributed Databases.
• To understand advanced DBMS techniques to construct tables and write effective queries, forms, and reports</td></tr>
<tr><td colspan="9">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="9">● Exposure for students to write complex queries including full outer joins, self-join, sub queries, and set theoretic queries.</td></tr>
<tr><td colspan="9">● Know how of the file organization, Query Optimization, Transaction management, and database administration techniques</td></tr>
<tr><td colspan="9">11. Unit wise detailed content</td></tr>
<tr><td colspan="2">Unit-1</td><td colspan="2">Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="9">Formal review of relational database and FDs Implication, Closure, its correctness
3NF and BCNF, Decomposition and synthesis approaches,Basics of query processing, external sorting, file scans</td></tr>
<tr><td colspan="2">Unit – 2</td><td colspan="2">Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="9">Processing of joins, materialized vs. pipelined processing, query transformation rules, DB transactions, ACID properties, interleaved executions, schedules, serializability</td></tr>
</table>

Unit – 3	**Number of lectures = 9**	
Correctness of interleaved execution, Locking and management of locks, 2PL, deadlocks, multiple level granularity, CC on B+ trees, Optimistic CC		
Unit – 4	**Number of lectures = 9**	
Time stamped, lock based techniques, Multiversion approaches, Comparison of CC methods, dynamic databases, Failure classification, recovery algorithm, XML and relational databases		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- A. Silberschatz, H. Korth, S. Sudarshan, Database system concepts, 5/e, McGraw Hill, 2008

Reference Books

- K. V. Iyer, Lecture notes available as PDF file for classroom use.
- R. Ramakrishnan, J. Gehrke, Database Management Systems, McGraw Hill, 2004

Semester II

Advanced Database Management System Lab

1. Course Name	**ADBMS Lab**	**L**	**T**		**P**	
2. Course Code	13070210	**0**	**0**		**2**	
3. Type of Course (use tick mark)		**Core (✔)**	**PE()**		**OE ()**	
4. Pre-requisite (if any)		**5. Frequency (use tick marks)**	Even (✔)	Odd ()	Either Sem ()	Every Sem ()
6. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 0		**Tutorials = 0**	**Practical = 24**			

7. Course Description: The aim of this course is to introduce students to the advanced concepts of database systems, focusing on the relational algebra and data model, query optimization and transactions.

8. Learning objectives:

- To explore the features of a Database Management Systems.
- To understand the internals of a database system.
- To present SQL and procedural interfaces to SQL comprehensively.

9. Course Outcomes (COs):

- Understand, appreciate and effectively explain the underlying concepts of database technologies
- Design and implement a database schema for a given problem-domain
- Normalize a database
- Populate and query a database using SQL DML/DDL commands.
- Declare and enforce integrity constraints on a database using a state-of-the-art DBMS

10. List of Experiments

1. Implementation of DDL commands of SQL with suitable examples :
    - Create table
    - Alter table
    - Drop table
2. Implementation of DML commands of SQL with suitable examples
    - Insert
    - Update
    - Delete
3. Implementation of different types of function with suitable examples
    - Number function
    - Aggregate Function
    - Character Function
    - Conversion Function
    - Date Function
4. Implementation of different types of operators in SQL
    - Arithmetic Operators
    - Logical Operators
    - Comparison Operator
    - Special Operator

- Set Operation

5. Implementation of different types of Joins
    - Inner Join
    - Outer Join
    - Natural Join etc.
6. Study and Implementation of
    - Group By & having clause
    - Order by clause
    - Indexing
7. Study & Implementation of
    - Sub queries
    - Views
8. Study & Implementation of different types of constraints.
9. Study & Implementation of Database Backup & Recovery commands.
10. Study & Implementation of Rollback, Commit, Save point.
    - Creating Database /Table Space
    - Managing Users: Create User, Delete User
    - Managing roles:-Grant, Revoke.
11. Study & Implementation of PL/SQL.
12. Study & Implementation of SQL Triggers.

11. Brief Description of self-learning / E-learning component

https://www.nitt.edu/home/academics/departments/cse/programmes/mtech/curriculum/semester_2/advanced_dbms_laboratory/

Semester II

Software Verification, Validation And Testing

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td colspan="2">2. Course Name</td><td colspan="2">Software Verification, Validation And Testing</td><td colspan="2">L</td><td colspan="2">T</td><td>P</td></tr>
<tr><td colspan="2">3. Course Code</td><td colspan="2">13070204</td><td colspan="2">3</td><td colspan="2">0</td><td>0</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td colspan="2">Core ()</td><td colspan="2">PE(✔)</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td>Computer Architecture, C</td><td colspan="2">6. Frequency (use tick marks)</td><td>Even (✔)</td><td>Odd ()</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="9">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 36</td><td colspan="3">Tutorials = 0</td><td colspan="3">Practical = 0</td></tr>
<tr><td colspan="9">8. Course Description</td></tr>
<tr><td colspan="9">The purpose of this course is to evaluate verification and validation theory</td></tr>
<tr><td colspan="9">9. Learning objectives:

1. To study fundamental concepts in software testing, including software testing objectives, process, criteria, strategies, and methods.
2. To discuss various software testing issues and solutions in software unit test; integration, regression, and system testing.
3. To learn how to planning a test project, design test cases and data, conduct testing operations, manage software problems and defects, generate a testing report.
4. To expose the advanced software testing topics, such as object-oriented software testing methods, and component-based software testing issues, challenges, and solutions.</td></tr>
<tr><td colspan="9">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="9">• Have an ability to apply software testing knowledge and engineering methods.</td></tr>
<tr><td colspan="9">• Have an ability to design and conduct a software test process for a software testing project.</td></tr>
<tr><td colspan="9">• Have an ability to identify the needs of software test automation, and define and develop a test tool to support test automation.</td></tr>
<tr><td colspan="9">• Have an ability to understand and identify various software testing problems, and solve these problems by designing and selecting software test models, criteria, strategies, and methods.</td></tr>
<tr><td colspan="9">11. Unit wise detailed content</td></tr>
<tr><td colspan="2">Unit-1</td><td colspan="2">Number of lectures = 09</td><td colspan="5">Testing terminology and Methodology</td></tr>
<tr><td colspan="9">Defs. of Failure, faults or bug, error, incident, test case, test ware, life cycle of bug, bug effects, bug classification, test case design, testing methodology, development of test, strategy, verification, validation, testing life cycle model, testing techniques, testing principles.</td></tr>
</table>

Unit – 2	**Number of lectures = 09**	**Verification and validation**
Verification activities, Verification of requirements, verification of HL design, Verification of data design, verification of architectural design, verification of UI design, verification of LL design, intro. to validation activities.		
Unit – 3	**Number of lectures = 09**	**Black & White Box testing & Static Testing**
Boundary value analysis, equivalence class portioning, state table based testing, decision table based, grappling, error guessing. Logic coverage criteria, basic path testing, graph matrices, loop testing, data flow testing, mutation testing. Types of static testing, technical reviews, inspections, inspection process, structured walk through, walk through process, Adv. of static testing.		
Unit – 4	**Number of lectures = 09**	**Test Automation and debugging**
S/w measurement and testing, testing metrics, tools debugging, design of practical test cases, reducing no. of test cases, regression testing and test case mgmt.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Software Testing and Analysis: Process, Principles and Techniques, Wiley, ISBN 0471455938., Mauro Pezzè, Michal Young, 2008, Wiley

Reference Books

- Foundations of Software Testing (2nd Edition),, Aditya P. Mathur, 2013, Pearson
- Software Engineering And Testing: An Introduction (Computer Science), B.B. Agarwal, M. Gupta, S.P. Tayal, Jones & Bartlett
- Software Engineering, "A practitioner's Approach" 8th Edition, Roger S. Pressman, Bruce R. Maxim, 2015, McGraw Hill International Edition

Semester II

Machine Learning

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td colspan="2">2. Course Name</td><td colspan="2">Neural Network</td><td colspan="2">L</td><td colspan="2">T</td><td>P</td></tr>
<tr><td colspan="2">3. Course Code</td><td colspan="2">13070205</td><td colspan="2">3</td><td colspan="2">0</td><td>0</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td colspan="2">Core ()</td><td colspan="2">PE(✔)</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td>Computer Network</td><td>Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">6. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 36</td><td colspan="2">Tutorials = 0</td><td colspan="3">Practical = 0</td></tr>
<tr><td colspan="8">7. Course Description</td></tr>
<tr><td colspan="8">This course will cover basic neural network architectures and learning algorithms, for applications in pattern recognition, image processing, and computer vision. Three forms of learning will be introduced (i.e., supervised, unsupervised and reinforcement learning) and applications of these will be discussed. The students will have a chance to try out several of these models on practical problems</td></tr>
<tr><td colspan="8">8. Learning objectives:
To make students familiar with basic concepts and tool used in neural networks
Teach students structure of a neuron including biological and artificial
To teach learning in network (Supervised and Unsupervised)
To teach concepts of learning rules</td></tr>
<tr><td colspan="8">9. Course Outcomes (COs):</td></tr>
<tr><td colspan="8">Superior for cognitive tasks and processing of sensorial data such as vision, image- and speech recognition, control, robotics, expert systems</td></tr>
<tr><td colspan="8">Design single and multi-layer feed-forward neural networks</td></tr>
<tr><td colspan="8">Understand supervised and unsupervised learning concepts & understand unsupervised learning using Kohonen networks</td></tr>
<tr><td colspan="8">To understand training of recurrent Hopfield networks and associative memory concepts.</td></tr>
<tr><td colspan="8">10. Unit wise detailed content</td></tr>
<tr><td colspan="2">Unit-1</td><td colspan="2">Number of lectures = 10</td><td colspan="4">Introduction</td></tr>
<tr><td colspan="8">Structure of biological neurons relevant to ANNs., Models of ANNs; Feedforward & feedback networks; learning rules; Hebbian learning rule, perception learning rule, delta learning rule, Widrow-Hoff learning rule, correction learning rule, Winner –lake all learning rule</td></tr>
<tr><td colspan="2">Unit – 2</td><td colspan="2">Number of lectures = 10</td><td colspan="4">Single layer Perception Classifier and Multi-layer Feed forward Networks</td></tr>
<tr><td colspan="8">Classification model, Features & Decision regions; training & classification using discrete perceptron, algorithm, single layer continuous perceptron networks for linearly separable classifications, linearly non-separable pattern classification, Delta learning rule for multi-perceptron layer, Generalized delta learning rule, Error back-propagation training, learning factors</td></tr>
</table>

Unit – 3	**Number of lectures = 08**	**Single layer feedback Networks**
Basic Concepts, Hopfield networks, Training & Examples. Associative memories: Linear Association, Basic Concepts of recurrent.		
Unit – 4	**Number of lectures = 08**	**Auto associative memory & Self organizing networks**
Retrieval algorithm, storage algorithm; By directional associative memory, Architecture, Association encoding & decoding, Stability. UN supervised learning of clusters, winner-take-all learning, recall mode, Initialization of weights, separability limitations.		

11. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

12. Books Recommended

Text Books

- Neural Network Fundamentals – N.K. Bose , P. Liang, 2002, T.M.H

Reference Books

- Neural Networks :A Comprehensive formulation - Simon Haykin, 1998, AW
- Neural Networks - Kosko, 1992, PHI.
- Neural Network - T.N.Shankar, University Science Press
- Neuro Fuzzy Systems - Lamba, V.K., University Science Press

Semester II

Ethical Hacking

1. Name of the Department- Computer Science and Engineering						
2. Course Name	**Ethical Hacking**	**L**	**T**		**P**	
3. Course Code	13070206	**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✔)**		**OE (✓)**	
5. Pre-requisite (if any)	**Knowledge of cyber security**	**6. Frequency (use tick marks)**	Even (✔)	Odd ()	Either Sem (✓)	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			

8. Course Description

The goal of this course is to help you master an ethical hacking methodology that can be used in a penetration testing or ethical hacking situation. You walk out the door with ethical hacking skills that are highly in demand.

9. Learning objectives:

The objective of this course is to give knowledge of computer systems architecture, programming, operating systems and databases, alongside specialist topics in digital forensics, legal issues, networking, ethical hacking and computer security.

10. Course Outcomes (COs):

On completion of this course, the students will be able to

- **i)** Establish type of attack on a given system.
- **ii)** Analyze nature and type of attack.
- **iii)** Simulate different types of attacks using tools
- **iv)** Design a secure system for protection from the various attacks by determining the need of security from various departments of an organization.

11. Unit wise detailed content

Unit-1	**Number of lectures = 09**	**Title of the unit: Introduction to Ethical Hacking**

Introduction, Networking & Basics, Foot Printing, Google Hacking, Scanning, Windows Hacking, Linux Hacking, Trojans &

Backdoors, Virus & Worms, Proxy & Packet Filtering, Denial of Service, Sniffer, Social Engineering,

Unit – 2	**Number of lectures = 09**	**Title of the unit: Introduction to Networking**

Introduction to Computer Systems and Networks , information systems and networks (including wireless networks) and their role in industry business and society, System and Network Vulnerability and Threats to Security , various types of attack and the various types of attackers in the context of the vulnerabilities associated with computer and information systems and networks Physical Security, Steganography, Cryptography, Wireless Hacking, Firewall & Honeypots, IDS & IPS, Vulnerability,

Penetration Testing, Session Hijacking.		
Unit – 3	**Number of lectures = 08**	**Title of the unit: Fundamentals of Hacking**
Hacking Web Servers, SQL Injection, Cross Site Scripting, Exploit Writing, Buffer Overflow, Reverse Engineering, Email Hacking, Incident Handling & Response, Bluetooth Hacking, Mobiles Phone Hacking. – Intrusion detection system – NIDS, HIDS – Penetrating testing process – Web Services – Reducing transaction risks.		
Unit – 4	**Number of lectures = 10**	**Title of the unit: Ethical issues**
An introduction to the particular legal, professional and ethical issues likely to face the domain of ethical hacking. ethical responsibilities, professional integrity and making appropriate use of the tools and techniques associated with ethical hacking.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

Journal papers; Patents in the respective field.

13. Books Recommended

- Hands-On Ethical Hacking and Network Defense – By Michael T. Simpson, Kent Backman, James Corley
- Official Certified Ethical Hacker Review Guide – By Steven DeFino, Barry Kaufman, Nick Valenteen
- The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy (Syngress Basics Series) [Paperback]

Semester II

Data Science

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td colspan="2">2. Course Name</td><td colspan="2">Data Science</td><td colspan="2">L</td><td colspan="2">T</td><td>P</td></tr>
<tr><td colspan="2">3. Course Code</td><td colspan="2">13070207</td><td colspan="2">3</td><td colspan="2">0</td><td>0</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td colspan="2">Core ()</td><td colspan="2">PE(✔)</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td>Basic Maths</td><td colspan="2">6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✔)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="9">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 36</td><td colspan="3">Tutorials = 0</td><td colspan="3">Practical = 0</td></tr>
<tr><td colspan="9">8. Course Description</td></tr>
<tr><td colspan="9">Data Science (DS) is a new, exponentially-growing field, which consists of a set of tools and techniques used to extract useful information from data. Data Science is an interdisciplinary, problem-solving oriented subject that learns to apply scientific techniques to practical problems. The course orients on practical classes and self-study during preparation of datasets and programming of data analysis tasks.</td></tr>
<tr><td colspan="9">9. Learning objectives:
• To develop fundamental knowledge of concepts underlying data science projects
• To explain how math and information sciences can contribute to building better algorithms and software.
• To develop applied experience with data science software, programming, applications and processes</td></tr>
<tr><td colspan="9">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="9">● Able to formulate the problem of knowledge extraction as combinations of data filtration, analysis and exploration methods.</td></tr>
<tr><td colspan="9">● Know basic notions and definitions in data analysis, machine learning.</td></tr>
<tr><td colspan="9">● Know standard methods of data analysis and information retrieval</td></tr>
<tr><td colspan="9">● Possess main software and development tools of data scientist</td></tr>
<tr><td colspan="9">● Learn to develop complex analytical reasoning.</td></tr>
<tr><td colspan="9">11. Unit wise detailed content</td></tr>
<tr><td colspan="2">Unit-1</td><td colspan="2">Number of lectures = 09</td><td colspan="5"></td></tr>
<tr><td colspan="9">Introduction to Data Science: Meaning of Data Science, Relationship between Big Data and Data Science, Benefits and uses of data science and big data. Facets of data: Structured versus Unstructured data, natural language, machine generated data, graph-based data, audio, image and video data
Data Science Process: Goal setting, retrieving data, data preparation, data cleansing and transformation, exploratory data analysis, data visualization, Model building and performance evaluation, presentation.</td></tr>
<tr><td colspan="2">Unit – 2</td><td colspan="2">Number of lectures = 09</td><td colspan="5"></td></tr>
<tr><td colspan="9">Data set and its features, Meaning of the terms: observations and variables, Discrete and continuous variables, quantitative and qualitative variables, dependent and independent variables, variables classified on scale: Nominal, Ordinal, Interval and Ratio variables.</td></tr>
<tr><td colspan="2">Unit – 3</td><td colspan="2">Number of lectures = 09</td><td colspan="5"></td></tr>
<tr><td colspan="9">Data Munging and data munging tasks: renaming variables, Data type conversion, encoding, decoding and recoding data, Merging datasets, transforming data, imputation, handling anomalous values,</td></tr>
</table>

missing values and outliers.

Unit – 4	**Number of lectures = 9**	

Machine Learning for Data Science: Meaning, definition and applications of machine learning, Steps involved in a machine learning project, Building a machine learning model: representing training examples, target function, representation of target function, learning algorithms, Basic terminology: features, feature vector, instance space, target function, training data, hypothesis space, inductive bias and Occam's razor principle. Bias versus variance, overfitting and underfitting.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Joel Grus, Data Science from Scratch, O'Reilly.
- Tom M. Mitchell, Machine Learning, McGraw Hill Education.

Reference Books

- Davy Cielen, Arno D.B. Meysman, Mohamed Ali, Introducing Data Science - Big Data, Machine Learning and More Using Python Tools, Manning Publications Co.
- Rachel Schutt & Cathy O'Neil, Doing Data Science, O'Reilly
- Jiawei Han, Micheline Kamber, Jian Pei , Data Mining Concepts and Techniques, Morgan Kaufmann.
- Ethem Alpaydin, Introduction to Machine Learning, PHI.
- Shai Shalev-Shwartz, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press.

Semester II

Virtual Reality

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td colspan="2">2. Course Name</td><td colspan="2">Virtual Reality</td><td colspan="2">L</td><td colspan="2">T</td><td>P</td></tr>
<tr><td colspan="2">3. Course Code</td><td colspan="2">13070208</td><td colspan="2">3</td><td colspan="2">0</td><td>0</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td colspan="2">Core ()</td><td colspan="2">PE(✔)</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td>Basic Maths</td><td>Frequency (use tick marks)</td><td>Even (✔)</td><td>Odd ()</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">6. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 36</td><td colspan="2">Tutorials = 0</td><td colspan="3">Practical = 0</td></tr>
<tr><td colspan="8">7. Course Description</td></tr>
<tr><td colspan="8">The aim of this course is to motivate the students to explore about virtual reality.</td></tr>
<tr><td colspan="8">8. Learning objectives:
• Fundamentals of virtual reality systems, including geometric modeling, transformations, graphical rendering, optics, the human vision, auditory, and vestibular systems, interface design, human factors, developer recommendations, and technological issues.</td></tr>
<tr><td colspan="8">9. Course Outcomes (COs):</td></tr>
<tr><td colspan="8">• Upon the completion of this course, the student will be able to:</td></tr>
<tr><td colspan="8">• Understanding of the fundamental concepts related to virtual reality system.</td></tr>
<tr><td colspan="8">10. Unit wise detailed content</td></tr>
<tr><td colspan="2">Unit-1</td><td>Number of lectures = 10</td><td colspan="5">Introduction</td></tr>
<tr><td colspan="8">Digital Course mechanics, Goals and VR definitions, Historical perspective, Birds-eye view (general), Birds-eye view (general), contd, Birds-eye view (hardware), Birds-eye view (software), Birds-eye view (sensation and perception)</td></tr>
<tr><td colspan="2">Unit – 2</td><td>Number of lectures = 08</td><td colspan="5">Geometry of Virtual Worlds</td></tr>
<tr><td colspan="8">Geometric modeling, Transforming models, Matrix algebra and 2D rotations, 3D rotations and yaw, pitch, and roll, 3D rotations and yaw, pitch, and roll, contd, Axis-angle representations, Quaternions, Converting and multiplying rotations, Converting and multiplying rotations, contd, Homogeneous transforms, The chain of viewing transforms, Eye transforms, Eye transforms, contd, Canonical view transform, Viewport transform, Viewport transform, contd</td></tr>
<tr><td colspan="2">Unit – 3</td><td>Number of lectures = 10</td><td colspan="5">Light & Optics and Visual Physiology</td></tr>
<tr><td colspan="8">Light & Optics: Image Three interpretations of light, Refraction, Simple lenses, Diopters, Imaging properties of lenses, Lens aberrations, Optical system of eyes

Visual Physiology: Photoreceptors, Sufficient resolution for VR, Light intensity, Eye movements, Eye movements, contd, Eye movement issues for VR, Neuroscience of vision</td></tr>
<tr><td colspan="2">Unit – 4</td><td>Number of lectures = 08</td><td colspan="5">Visual Perception & Tracking Systems</td></tr>
</table>

Visual Perception: Depth perception, Depth perception, contd, Motion perception, Frame rates and displays, Frame rates and displays contd

Tracking Systems: Shape Overview, Orientation tracking, Tilt drift correction, Yaw drift correction, Tracking with a camera, Perspective n-point problem, Filtering, Lighthouse approach

11. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

12. Books Recommended

Text Books

- George Mather, Foundations of Sensation and Perception: Psychology Press; 2 edition, 2009.

Reference Books

- Peter Shirley, Michael Ashikhmin, and Steve Marschner, Fundamentals of Computer Graphics, A K Peters/CRC Press; 3 edition, 2009.

Semester III

Artificial Intelligence

1. Name of the Department- Computer Science & Engineering						
2. Course Name	**Artificial Intelligence**	**L**	**T**		**P**	
3. Course Code	13070301	**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core (✔)**	**PE()**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even	Odd (✔)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			

8. Course Description

This course Artificial Intelligence (AI) is designed to help learners decode the mystery of artificial intelligence (AI) and its business applications. This course provides an overview of AI concepts and workflows, machine learning and deep learning, and performance metrics.

9. Learning objectives:

- To introduce the basic principles, techniques, and applications of Artificial Intelligence.
- To cover knowledge representation, logic, inference, problem solving, search algorithms, game theory, perception, learning, planning, and agent design.
- To experience programming in AI language tools.

10. Course Outcomes (COs):

- To apply the basic principles, models, and algorithms of **AI** to recognize, model.
- To solve problems in the analysis and design of information systems.
- To analyze the structures and algorithms of a selection of techniques related to searching, reasoning, machine learning, and language processing.

11. Unit wise detailed content

Unit-1	**Number of lectures = 09**	

Introduction: Background and history, Overview of AI applications areas.

The predicate calculus: Syntax and semantic for propositional logic and FOPL, Clausal form, inference rules, resolution and unification.

Knowledge representation: Network representation-Associative network & conceptual graphs, structured representation- Frames & Scripts.

Intelligent Agents, Structure of Intelligent Agents

Unit – 2	**Number of lectures = 09**	

Search strategies: Strategies for state space search-data driven and goal driven search; Search algorithms- uninformed search (depth first, breadth first, depth first with iterative deepening) and informed search (Hill climbing, best first, A* algorithm, mini-max etc.), computational complexity, Properties of search algorithms-Admissibility, Monotonicity, Optimality, Dominance, etc.

Production system: Types of production system, Control of search in production system.

Unit – 3	**Number of lectures = 09**	

Rule based expert systems: Architecture, development, managing uncertainty in expert systems(Bayesian probability theory, Stanford certainty factor algebra, Nonmonotonic logic and reasoning with beliefs, Fuzzy logic, Dempter/Shaffer and other approaches to uncertainty.

Knowledge acquisition: Types of learning, learning automata, genetic algorithms, intelligent editors, learning by induction.

Unit – 4	**Number of lectures = 09**	

Machine Learning and Pattern Recognition: Supervised and unsupervised learning, Decision trees, Statistical learning models, Learning with complete data - Naive Bayes models, Learning with hidden data – EM algorithm, Reinforcement learning, Design principles of pattern recognition system, Statistical Pattern recognition, Parameter estimation methods - Principle Component Analysis (PCA) and Linear Discriminant Analysis (LDA), Classification Techniques – Nearest Neighbour (NN) Rule, Bayes Classifier, Support Vector Machine (SVM), K – means clustering.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/AI

13. Books Recommended

Text Books

- George F. Luger, William A. Stubblefield, Artificial Intelligence, The Benjamin / Cummings Publishing Company, Inc

14. Reference Books

- Dan W. Patterson Introduction to Artificial Intelligence and Expert system PHI
- Eugene Charniak, Drew McDermott Introduction to Artificial Intelligence Addison Wesley.
- Guide to expert systems, Donald A. Waterman, Pearson Education.
- Nils J. Nilsson Principles of Artificial Intelligence Narosa publishing house.
- Jackson Peter, Introduction to Expert systems, 3rd ed., (Addison Wesley)

Semester III

Artificial Intelligence Lab

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td colspan="2">2. Course Name</td><td>Artificial Intelligence Lab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td colspan="2">3. Course Code</td><td>13070309</td><td>0</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td>Core (✔)</td><td colspan="2">PE( )</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="3">5. Pre-requisite (if any)</td><td>6. Frequency (use tick marks)</td><td>Even</td><td>Odd (✔)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 0</td><td>Tutorials = 0</td><td colspan="4">Practical = 24</td></tr>
<tr><td colspan="8">8. Course Description</td></tr>
<tr><td colspan="8">9. Learning objectives:
• To acquire knowledge on intelligent systems and agents, formalization of knowledge, reasoning with and without uncertainty, machine learning and applications at a basic level.
• To Design appropriate heuristics for a particular problem</td></tr>
<tr><td colspan="8">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="8">• Understand basic principles and techniques of intelligent systems and their practical applications.</td></tr>
<tr><td colspan="8">• Formalization and design of systems capable of automated reasoning.</td></tr>
<tr><td colspan="8">• Implementation and application of machine learning techniques in prediction problems.</td></tr>
<tr><td colspan="8">• Implementation and application of data mining techniques</td></tr>
<tr><td colspan="8">• Formalize and implement constraints in search problems</td></tr>
<tr><td colspan="8">11. List of Experiments</td></tr>
<tr><td colspan="8">1) Program to implement binary search algorithm.
2) Program to implement quick sort algorithm.
3) Program to implement depth first spanning tree.
4) Program to implement Knapsack problem.
5) Program to implement Strassen Multiplication.
6) Program to implement Matrix Multiplication using Divide and Conquer Approach.
7) Program to implement the Traveling Salesman Problem.
8) Program to implement Depth First Search using Traversal Method.
9) Program to implement Breadth First Search using Traversal Method.
10) Study of Machine Learning and Machine learning algorithms.
11) Program to implement 8 -Queen Problem.
12) Program to implement 15 –Puzzle problem.</td></tr>
</table>

During the course student must be do project on:

1. Online Logistic Chatbot System (Student can make a client-server chat module so that it will be easy for client to make any query any time at any location regarding any object)
2. Facial Emotion Recognition (Student can design an application for judging/recognize emotions of any kind on face)
3. Question paper generator system (A database of all related questions can be made, at last it automatically generates a question paper as per required pattern.)
4. Online AI Shopping With M-Wallet System (A user can make a shopping application by which shopping of objects can be done with AI means with the help of a mobile wallet.)

At least one Project is mandatory for each student.

12. Brief Description of self-learning / E-learning component

https://nlp-iiith.vlabs.ac.in/
http://vlab.co.in/participating-institute-iiit-hyderabad

Semester III

Data Mining

1. Name of the Department- Computer Science & Engineering						
2. Course Name	**Data Mining**	**L**	**T**		**P**	
3. Course Code	13070302	**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core (✔)**	**PE()**		**OE ()**	
5. Pre-requisite (if any)	Database concepts	**6. Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			

8. Course Description

The purpose of this course is to provide basic concepts of data mining and its applications.

Learning objectives:

- To study the methodology of engineering legacy databases for data mining to derive business rules for decision support systems.
- To analyze the data, identify the problems, and choose the relevant models and algorithms to apply.

9. Course Outcomes (COs):

- Enable students to understand and implement classical algorithms in data mining
- Students will be able to assess the strengths and weaknesses of the algorithms, identify the application area of algorithms, and apply them.
- Students would learn data mining techniques as well as methods in integrating and interpreting the data sets and improving effectiveness, efficiency and quality for data analysis.

10. Unit wise detailed content

Unit-1	**Number of lectures = 09**	**Introduction to Data Mining**

Introduction: Basic concepts of Data Mining, Related technologies (Machine Learning, DBMS,OLAP, Statistics),Data Mining Goals, Stages of the Data Mining Process, Data Mining Tasks ,Knowledge Representation Methods, Applications of Data Mining, Major Challenges and Issues in Data Mining Data pre-processing: Data cleaning, Data transformation, Data reduction, Discretization

Unit – 2	**Number of lectures = 09**	**Association Rule Mining:**

Association Rule Mining: Introduction and Basic Concepts, Motivation and terminology, Examples of Association rule mining, Basic Algorithms, Parallel and Distributed Algorithms, Comparing Approaches, Incremental Rules, Advanced Association Rule Techniques, Measuring the Quality of Rules

Classifications and Prediction: Basic Concepts, Decision Tree induction, Bayes Classification Methods, Rule Based Classification, Model Evaluation and Selection, Techniques to Improve Classification Accuracy

Unit – 3	Number of lectures = 09	Cluster Analysis:

Cluster Analysis: Basic concepts and Methods, Cluster Analysis, Partitioning methods, Hierarchical methods, Density based Methods, Grid Based Methods, Evaluation of Clustering

Advanced Cluster Analysis: Probabilistic model based clustering, Clustering High, Dimensional Data, Clustering Graph and Network Data, Clustering with Constraints

Outlier Analysis: Basic concepts of Outlier analysis, Types of Outliers, Challenges of Outlier Detection, Outlier Detection Methods, Statistical approaches, Proximity-Based Approaches,

Unit – 4	Number of lectures = 09	Text mining:

Text mining: Basic Concepts, Extracting attributes (Keywords), structural approaches (parsing, soft parsing) ,Web Mining: Introduction, Classifying web pages, extracting knowledge from the web ,Overview of Data Mining Software and Applications: Case Study: WEKA

11. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

12. Books Recommended

Text Books

- Jiawei Han, Micheline Kamber, Jain Pei, "Data Mining: Concepts and Techniques",Third Edition (The Morgan Kaufmann Series in Data Management System), 2012

Reference Books

- David J. Hand, Heikki Mannila and Padhraic Smyth "Principles of Data Mining"(Adaptive Computation and Machine learing), 2005
- Margaret H Dunham, "Data Mining: Introductory and Advanced Topics", 2003iv. Soman, K.P., Diwakar Shyam and Ajay V. "Insight into Data Mining: Theory and Practices", PHI, 2009.

Semester III

Cloud Computing

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td colspan="2">2. Course Name</td><td colspan="2">Cloud Computing</td><td colspan="2">L</td><td colspan="2">T</td><td>P</td></tr>
<tr><td colspan="2">3. Course Code</td><td colspan="2">13070303</td><td colspan="2">3</td><td colspan="2">0</td><td>0</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td colspan="2">Core (✔)</td><td colspan="2">PE()</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td>Computer Network, Operating System, Algorithms</td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✔)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 36</td><td colspan="2">Tutorials = 0</td><td colspan="3">Practical = 0</td></tr>
<tr><td colspan="8">8. Course Description</td></tr>
<tr><td colspan="8">This course covers a series of current cloud computing technologies, including technologies for Infrastructure as a Service, Platform as a Service, Software as a Service, and Physical Systems as a Service. The course is also highly project oriented, involving hand-on exploration of existing technologies as well as development of new technologies.</td></tr>
<tr><td colspan="8">9. Learning objectives:
• To introduce Cloud Computing Technologies as used in Industry.
• To give understanding Service Models & Deployment Model in Cloud Computing.
• To familiarize the Concept of Virtualization & learn the use cases of Cloud Computing with the help of Case Study.</td></tr>
<tr><td colspan="8">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="8">● Applying key comparative methodologies to assess the comparative advantages and disadvantages of public vs. private computing clouds</td></tr>
<tr><td colspan="8">● Applying relevant methods to assess the important security and sustainability challenges involved in adopting various cloud architectures</td></tr>
<tr><td colspan="8">● Applying Cloud Computing to Industry Use Cases</td></tr>
<tr><td colspan="8">11. Unit wise detailed content</td></tr>
<tr><td colspan="2">Unit-1</td><td colspan="2">Number of lectures = 09</td><td colspan="4"></td></tr>
<tr><td colspan="8">Introduction to Cloud Computing, History of Cloud Computing, Cloud service providers, Pros and Cons of Cloud Computing, Benefits of Cloud Computing, Cloud computing vs. Cluster computing vs. Grid computing.</td></tr>
<tr><td colspan="2">Unit – 2</td><td colspan="2">Number of lectures = 09</td><td colspan="4"></td></tr>
<tr><td colspan="8">Cloud Computing Architecture, Service Models (XaaS), Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service(SaaS). Application of Service Models.</td></tr>
</table>

Unit – 3	**Number of lectures = 09**	
Deployment Models, Public cloud, Private cloud, Hybrid cloud, Community cloud,Concept of Virtualisation, Cloud security, Cloud Economics		
Unit – 4	**Number of lectures = 09**	
Case Study on Open Source & Commercial Clouds: Eucalyptus, Microsoft Azure, Amazon EC2.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Cloud Computing (Wind) by Dr. Kumar Saurabh, 2nd Edison, Wiley India

Reference Books

- Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wile, 2011
- Cloud Computing: Principles, Systems and Applications, Editors: Nikos Antonopoulos, Lee Gillam, Springer, 2012

Semester III

Software Project Management

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td colspan="2">2. Course Name</td><td colspan="2">Software Project Management</td><td colspan="2">L</td><td colspan="2">T</td><td>P</td></tr>
<tr><td colspan="2">3. Course Code</td><td colspan="2">13070304</td><td colspan="2">3</td><td colspan="2">0</td><td>0</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td colspan="2">Core ()</td><td colspan="2">PE(✔)</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td>Programming Language, Software Engg.</td><td colspan="2">6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✔)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="9">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 36</td><td colspan="3">Tutorials = 0</td><td colspan="3">Practical = 0</td></tr>
<tr><td colspan="9">8. Course Description</td></tr>
<tr><td colspan="9">This course covers the concept of software management and its different phases.</td></tr>
<tr><td colspan="9">9. Learning objectives:
• Identify the different project contexts and suggest an appropriate management strategy.
• Practice the role of professional ethics in successful software development.
• Identify and describe the key phases of project management.
• Determine an appropriate project management approach through an evaluation of the business context and scope of the project.</td></tr>
<tr><td colspan="9">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="9">• Understand the fundamental principles of Software Project management & will also have a good knowledge of responsibilities of project manager and how to handle these.</td></tr>
<tr><td colspan="9">• Be familiar with the different methods and techniques used for project management.</td></tr>
<tr><td colspan="9">• Will also be able to understand why majority of the software projects fails and how that failure probability can be reduced effectively.
• Will be able to do the to do the Project Scheduling, tracking, Risk analysis, Quality management and Project Cost estimation using different techniques Project Scheduling, tracking, Risk analysis, Quality management and Project Cost estimation using different techniques.</td></tr>
<tr><td colspan="9">11. Unit wise detailed content</td></tr>
<tr><td colspan="2">Unit-1</td><td colspan="2">Number of lectures = 09</td><td colspan="5">PROJECT CONCEPTS AND ITS MANAGEMENT</td></tr>
<tr><td colspan="9">Project life cycle models-ISO 9001 model-Capability Maturity Model-Project Planning-Project tracking-Project closure. Evolution of Software Economics – Software Management Process Framework: Phases, Artifacts, Workflows, Checkpoints – Software Management Disciplines: Planning / Project Organization and Responsibilities / Automation / Project Control – Modern Project Profiles</td></tr>
</table>

Unit – 2	Number of lectures = 09	COST ESTIMATION
Problems in Software Estimation – Algorithmic Cost Estimation Process, Function Points, SLIM (Software Life cycle Management), COCOMO II (Constructive Cost Model) – Estimating Web Application Development – Concepts of Finance, Activity Based Costing and Economic Value Added (EVA) – Balanced Score Card.		
Unit – 3	**Number of lectures = 09**	**SOFTWARE QUALITY MANAGEMENT**
Software Quality Factors – Software Quality Components – Software Quality Plan – Software Quality Metrics – Software Quality Costs – Software Quality Assurance Standard – Certification – Assessment. Software Configuration Management – Risk Management: Risk Assessment: Identification / Analysis / Prioritization. Risk Control: Planning / Resolution / Monitoring. Software Metrics – Classification of Software Metrics: Product Metrics: Size Metrics, Complexity Metrics, Halstead's Product Metrics, Quality Metrics, and Process metrics		
Unit – 4	**Number of lectures = 09**	**PROJECT EVALUATION AND EMERGING TRENDS**
Strategic Assessment–Technical Assessment–Cost Benefit Analysis–Cash Flow Forecasting–Cost Benefit Evaluation Technique–Risk Evaluation–Software Effort Estimation. Emerging Trends: Import of the internet on project Management – people Focused Process Models.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Bob hughes and Mike Cotterell, "Software Project Management" second edition,1999.
- Royce, W. "Software Project Management: A Unified Framework", AddisonWesley, 1998.

Reference Books

- Ramesh Gopalaswamy , "Managing and global Software Projects", Tata McGraw Hill Tenth Reprint, 2011.
- Fenton, N.E., and Pfleeger, S.L.. "Software Metrics: A Rigorous and Practical Approach, Revised" Brooks Cole, 1998.
- Kaplan, R.S., Norton, D.P. "The Balanced Scorecard: Translating Strategy into Action", Harvard Business School Press, 1996.
- Boehm, B. W. "Software Risk Management: Principles and Practices" in IEEE Software, January 1991, pp32-41.
- Roger S.Pressman, "Software Engineering- A Practitioner's Approach", 7th Edition ,McGraw Hill, 2010.

Semester III

Deep learning

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td colspan="2">2. Course Name</td><td colspan="2">Deep learning</td><td colspan="2">L</td><td colspan="2">T</td><td>P</td></tr>
<tr><td colspan="2">3. Course Code</td><td colspan="2">13070305</td><td colspan="2">3</td><td colspan="2">0</td><td>0</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td colspan="2">Core ()</td><td colspan="2">PE(✔)</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td>Machine Learning</td><td>Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✔)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">6. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 36</td><td colspan="2">Tutorials = 0</td><td colspan="3">Practical = 0</td></tr>
<tr><td colspan="8">7. Course Description</td></tr>
<tr><td colspan="8">The aim of this course is to motivate the students an intrinsic interest in deep learning.</td></tr>
<tr><td colspan="8">8. Learning objectives:
The objective of this course is to cover the fundamentals of neural networks as well as some advanced topics such as recurrent neural networks, long short-term memory cells and convolutional neural networks.</td></tr>
<tr><td colspan="8">9. Course Outcomes (COs):</td></tr>
<tr><td colspan="8">• Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.</td></tr>
<tr><td colspan="8">• Implement deep learning algorithms and solve real-world problems.</td></tr>
<tr><td colspan="8">10. Unit wise detailed content</td></tr>
<tr><td colspan="2">Unit-1</td><td colspan="2">Number of lectures = 8</td><td colspan="4">Introduction & Feedforward networks</td></tr>
<tr><td colspan="8">Introduction: Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm.

Feedforward Networks: Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization.</td></tr>
<tr><td colspan="2">Unit – 2</td><td colspan="2">Number of lectures = 10</td><td colspan="4">Deep Neural Networks & Training of Neural networks</td></tr>
<tr><td colspan="8">Deep Neural Networks: Difficulty of training deep neural networks, Greedy layerwise training.

Better Training of Neural Networks: Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization).</td></tr>
<tr><td colspan="2">Unit – 3</td><td colspan="2">Number of lectures = 10</td><td colspan="4">Convolution & Recurrent Neural Networks</td></tr>
<tr><td colspan="8">Convolutional Neural Networks: Architectures, convolution / pooling layers , LeNet, AlexNet.</td></tr>
</table>

Recurrent Neural Networks: Back propagation through time, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs.

Unit – 4	**Number of lectures = 08**	**Generative models & Deep unsupervised learning and recent trends**

Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines.

Deep Unsupervised Learning and Recent Trends: Autoencoders (standard, sparse, denoising, contractive, etc), Variational Autoencoders, Adversarial Generative Adversarial Networks, Autoencoder and DBM , Multi- task Deep Learning, Multi-view Deep Learning.

11. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

12. Books Recommended

Text Books

- Ian Goodfellow and Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016.

Reference Books

- Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006
- Raúl Rojas, Neural Networks : A Systematic Introduction, Springer, 1996

Semester III

Information & Security Management

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td colspan="2">2. Course Name</td><td colspan="2">Information & Security Management</td><td colspan="2">L</td><td colspan="2">T</td><td>P</td></tr>
<tr><td colspan="2">3. Course Code</td><td colspan="2">13070306</td><td colspan="2">3</td><td colspan="2">0</td><td>0</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td colspan="2">Core ()</td><td colspan="2">PE(✔)</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td>Programming Language, Computer network</td><td colspan="2">6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✔)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="9">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 36</td><td colspan="3">Tutorials = 0</td><td colspan="3">Practical = 0</td></tr>
<tr><td colspan="9">8. Course Description</td></tr>
<tr><td colspan="9">This course covers a concept of cryptography, security and governance.</td></tr>
<tr><td colspan="9">9. Course Outcomes (COs):</td></tr>
<tr><td colspan="9">• Analyze and evaluate the cyber security needs of an organization.</td></tr>
<tr><td colspan="9">• Determine and analyze software vulnerabilities and security solutions to reduce the risk of exploitation.</td></tr>
<tr><td colspan="9">• Measure the performance and troubleshoot cyber security systems.</td></tr>
<tr><td colspan="9">10. Unit wise detailed content</td></tr>
<tr><td colspan="2">Unit-1</td><td colspan="2">Number of lectures = 09</td><td colspan="5">MYTHS OF INFORMATION SECURITY MANAGEMENT</td></tr>
<tr><td colspan="9">The big picture-Learning from experience-Weaknesses in Information Security. The extent of crime in cyberspace- The cyberspace crimoid syndrome-Policies and technologies - A new framework for information security.</td></tr>
<tr><td colspan="2">Unit – 2</td><td colspan="2">Number of lectures = 09</td><td colspan="5">INFORMATION SECURITY ASSESSMENTS</td></tr>
<tr><td colspan="9">Risk Assessment- Richard Baskerville’s risk assessment methodology Generations of risk assessment techniques- Quantitative approach to risk assessment-Problems with Quantitative approach – NIST ALE- Baseline approach.</td></tr>
<tr><td colspan="2">Unit – 3</td><td colspan="2">Number of lectures = 09</td><td colspan="5">SECURITY MANAGEMENT CONCEPTS AND PRINCIPLES & CONFIGURATION MANAGEMENT</td></tr>
<tr><td colspan="9">Measuring ROI on security- Security patch management- Purposes of Information Security management- The building blocks of information security- Human side of information security- Security management- Securing new information technology.
Overview of SSE CMM- SSE CMM relationship to other initiatives- Capability levels- Security</td></tr>
</table>

Engineering- Security Engineering process overview- Basic process areas- Configuration management- Base practices- Establish configuration management.		
Unit – 4	**Number of lectures = 09**	**SECURITY MANAGEMENT PLANNING**
Maintaining information security during downsizing- Business case for Information Security- Information Security Management in healthcare industryProtecting high tech trade secrets- Outsourcing Security.		
11. Brief Description of self-learning / E-learning component The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal. https://elearning.sgtuniversity.ac.in/course-category/		
12. Books Recommended		
Text Books ● Micki Krause, Harold F.Tripton, " Information Security Management Handbook",Auerbach Publications, 2012.		
Reference Books		
● Donn Parkers, " Fighting Computer Crime: "A New Framework for Protecting Information", John Wiley&Sons, 2003.		

Semester III

Big Data & Hadoop

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td colspan="2">2. Course Name</td><td colspan="2">Big Data & Hadoop</td><td colspan="2">L</td><td colspan="2">T</td><td>P</td></tr>
<tr><td colspan="2">3. Course Code</td><td colspan="2">13070307</td><td colspan="2">3</td><td colspan="2">0</td><td>0</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td colspan="2">Core ()</td><td colspan="2">PE(✔)</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td>Cloud Computing</td><td colspan="2">6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✔)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="9">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 36</td><td colspan="3">Tutorials = 0</td><td colspan="3">Practical = 0</td></tr>
<tr><td colspan="9">8. Course Description</td></tr>
<tr><td colspan="9">Today’s world is data-driven world. Increasingly, the efficient operation of organizations across sectors relies on the effective use of vast amounts of data. This course provides grounding in basic and advanced analytic methods and an introduction to big data analytics technology and tools.</td></tr>
<tr><td colspan="9">9. Learning objectives:
Learn about the basics of data Science and to understand the various supervised and unsupervised learning techniques.
Bring together several key technologies used for manipulating, storing, and analyzing big data from advanced analytics perspectives.
Realize the Hadoop architecture and implementation of MapReduce Application.</td></tr>
<tr><td colspan="9">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="9">Understanding of Big Data problems with easy to understand examples</td></tr>
<tr><td colspan="9">History and advent of Hadoop right from when Hadoop wasn’t even named Hadoop</td></tr>
<tr><td colspan="9">What is Hadoop Magic which makes it so unique and powerful</td></tr>
<tr><td colspan="9">Understanding the difference between Data science and data engineering, which is one of the big confusions in selecting a carrier or understanding a job role.</td></tr>
<tr><td colspan="9">11. Unit wise detailed content</td></tr>
<tr><td colspan="2">Unit-1</td><td colspan="2">Number of lectures = 09</td><td colspan="5"></td></tr>
<tr><td colspan="9">Data Import and Export, Attribute and Data Types, Descriptive Statistics, Exploratory Data Analysis, Visualization Before Analysis, Dirty Data, Visualizing a Single Variable, Examining Multiple Variables, Data Exploration Versus Presentation</td></tr>
<tr><td colspan="2">Unit – 2</td><td colspan="2">Number of lectures = 09</td><td colspan="5"></td></tr>
<tr><td colspan="9">Working with Big Data:
Google File System, Hadoop Distributed File System (HDFS) — Building blocks of Hadoop(Namenode, Datanode, Secondary Namenode, JobTracker, TaskTracker), Introducing and Configuring Hadoop cluster (Local,Pseudo-distributed mode, Fully Distributed mode), Configuring XML files.Writing MapReduce Programs:</td></tr>
<tr><td colspan="2">Unit – 3</td><td colspan="2">Number of lectures = 09</td><td colspan="5"></td></tr>
<tr><td colspan="9">Hadoop l/O:
The Writable Interface, WritableComparable and comparators, Writable Classes: Writable wrappers for Java primitives, Text, BytesWritable, Nul1Writable, ObjectWritable and Genericwritable, Writable</td></tr>
</table>

collections, Implementing a Custom Writable: Implementing a RaWComparator for speed, Custom comparators		
Unit – 4	**Number of lectures = 9**	
Pig: Hadoop Programming Made Easier Admiring the Pig Architecture, Going with the Pig Latin Application Flow, Working through the ABCs of Pig Latin, Evaluating Local and Distributed Modes of Running Pig Scripts, Checking out the Pig Script Interfaces, Scripting with Pig Latin		
12. Brief Description of self-learning / E-learning component The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal. https://elearning.sgtuniversity.ac.in/course-category/		
13. Books Recommended		
Text Books ● Hadoop: The Definitive Guide by Tom White, 3rd Edition, O'reilly Hadoop in Action by ● Chuck Lam, MANNING Publ ● Hadoop: The Definitive Guide by Tom White, 3rd Edition, O'reilly		
Reference Books		
Hadoop for Dummies by Dirk deR0os, Paul C.Zikopoulos, Roman B.Melnyk,Bruce Brown,		

Semester III

Augmented Reality

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td colspan="2">2. Course Name</td><td colspan="2">Augmented Reality</td><td colspan="2">L</td><td colspan="2">T</td><td>P</td></tr>
<tr><td colspan="2">3. Course Code</td><td colspan="2">13070308</td><td colspan="2">3</td><td colspan="2">0</td><td>0</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td colspan="2">Core ()</td><td colspan="2">PE(✔)</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td>Basic programming experience and experience with 3D graphics software is highly recommended.</td><td>Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✔)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">6. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 36</td><td colspan="2">Tutorials = 0</td><td colspan="3">Practical = 0</td></tr>
<tr><td colspan="8">7. Course Description</td></tr>
<tr><td colspan="8">The aim of this course is to teach the fundamentals of augmented reality (AR), and how to build an AR experience using AR Core</td></tr>
<tr><td colspan="8">8. Learning objectives:
The This course will break down complex AR concepts to make them easy to understand. The course is great for beginners who are just getting started with AR or ARCore.</td></tr>
<tr><td colspan="8">9. Course Outcomes (COs):</td></tr>
<tr><td colspan="8">• How to identify different types of AR experiences</td></tr>
<tr><td colspan="8">• Tools and platforms used in the AR landscape</td></tr>
<tr><td colspan="8">• What makes AR feel "real"</td></tr>
<tr><td colspan="8">• Popular use cases for AR</td></tr>
<tr><td colspan="8">10. Unit wise detailed content</td></tr>
<tr><td colspan="2">Unit-1</td><td colspan="2">Number of lectures = 8</td><td colspan="4">The Introduction to augmented reality (AR)</td></tr>
<tr><td colspan="8">The Introduction to augmented reality (AR): Basics of augmented reality and some surrounding context-- how and why it was developed, and how it compares to and differs from its technological cousin, virtual reality. You will also learn more about the current industry landscape, the hardware needed to view AR content, and how people are using AR today.</td></tr>
<tr><td colspan="2">Unit – 2</td><td colspan="2">Number of lectures = 10</td><td colspan="4">The basics of AR functionality</td></tr>
<tr><td colspan="8">The basics of AR functionality: In this module we’ll dive into the hardware components inside mobile devices that power augmented reality, and you'll discover ways in which AR assets can feel real and keep users immersed. You'll learn about ARCore features that help make a digital object behave as</td></tr>
</table>

though it exists in a real world space, as well as a few constraints facing AR today.

Unit – 3	**Number of lectures = 10**	**ARCore**

ARCore: In this section you'll dive into a few specific examples of how AR applications are being used in the real world. You'll learn about the strengths and current constraints of the ARCore platform, user considerations, and basic AR interaction options. You'll also gain more knowledge about the tools and team you'll need to build an AR app.

Unit – 4	**Number of lectures = 08**	**Bringing ARCore to life**

Bringing ARCore to life: In this last module we'll dive deeper into some important elements of augmented reality and bring them to life with existing ARCore apps. You'll also learn more about how to create 3D assets for AR with tools like Google Poly and Unity, as well as discover further resources to continue your augmented reality learning journey.

11. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

12. Books Recommended

Text Books

- Dieter Schmalstieg and Tobias Hollerer, "Augmented Reality: Principles and Practice", 2016.

Reference Books

- Oliver Bimber and Ramesh Raskar, "Spatial Augmented Reality: Meging Real and Virtual Worlds", 2005