Program: B. Tech (Computer Science and Business Systems)				**Semester:** VII	
Course: Usability Design of Software Applications				**Code:** BTCS07001	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 50)**	**Term End Examinations (TEE) (Marks - 100)**
2	2	0	3	Marks Scaled to 50	Marks Scaled to 50

Pre-requisite: Software engineering, SDUML

Course Objective

The major emphasis of the course will be on creating a learning system through which management students can enhance their innovation and creative thinking skills, acquaint themselves with the special challenges of starting new ventures and use IPR as an effective tool to protect their innovations and intangible assets from exploitation.

Course Outcomes

After completion of the course, the student will be able to -

1. Understand the fundamentals of User Centered Design and User Experience their relevance and contribution to businesses
2. Evaluation of heuristic principles
3. Analyse the research activities and design thinking activities
4. Apply concept development

Detailed Syllabus:

Unit	Description	Duration
1	Introduction to User Centred Design: Aspects of User Centered Design, Product Appreciation Assignment – Evaluating the product from user centered design aspects such as functionality, ease of use, ergonomics, aesthetics	**4**
2	Heuristic Evaluation: 10 Heuristic Principles, Examples; Heuristic Evaluation: Group Assignment initiation (Website and App, Evaluation for key tasks of the app or website for heuristic principles, severity, recommendations.	**5**
3	Usability focused Project development: Introduce concepts of website/ application redesigning practice redesign through the design life cycle: Discovery, define, design, Implement (Design prototype), Usability Testing.	**7**
4	UX Research: Understanding users, their goals, context of use, environment of use, Research Techniques: Contextual Enquiry, User Interviews, Competitive Analysis for UX, Scenarios and Persona Technique, Presentation of Personas for the group project, Design thinking technique, Discovery and brainstorming	**8**
5	Concept Development:	**6**

	Task flow detailing for the Project, Prototyping Techniques: Paper, Electronic, Prototyping Tools, Project Prototyping Iteration 1, Project Prototyping Iteration 2, Project review and feedback, Final presentation of solution	
	Total	**30**

Text Books:

1. Jennifer Preece, Helen Sharp and Yvonne Rogers, *Interaction Design: Beyond Human-Computer Interaction,* (4th Edition), Wiley publication, August 2015
2. Alan Cooper and Robert Reimann, *About Face*, (4th Edition), Wiley publication
3. Elizabeth Goodman, Mike Kuniavsky and Andrea Moed, *Observing the User Experience*, Second Edition: A Practitioner's Guide to User Research", (2nd Edition), MK publisher
4. Jesse James Garrett, *The Elements of User Experience: User-Centered Design for the Web and Beyond*, (2nd Edition), New Riders Publication
5. Jonny Schneider, *Understanding Design Thinking, Lean, and Agile*, O'Reilly Media, Inc.

References:

1. Janice C. Redish JoAnn T. Hackos, *User and Task Analysis for Interface Design*, John Wiley & Sons publication
2. J. Tidal, *Usability and the Mobile Web (LITA Guides)*

Laboratory Work

8 to 10 experiments (and a practicum where applicable) based on the syllabus

Seema Shah

Signature
(Head of the Department)

Program: B. Tech (Computer Science and Business Systems)				**Semester:** VII	
Course: IT Workshop Skylab/ Matlab				**Code:** BTCS07002	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 50)**	**Term End Examinations (TEE) (Marks - 100)**
2	2	0	3	Marks Scaled to 50	Marks Scaled to 50

Pre-requisite: Fundamentals of Computer Science, Object Oriented Programming, Basics of Engineering Mathematics

Course Objective

The objective of the course is to give a hands-on introduction to the MATLAB technical computing environment.

Course Outcomes

After completion of the course, the student will be able to:

1. understand the basic features and commands of MATLAB
2. implement mathematical functions and generate plots using MATLAB
3. apply basic flow control structure and write scripts using MATLAB
4. Implement and debug programs using MATLAB

Detailed Syllabus:

Unit	Description	Duration
1	Introduction to MATLAB History, basic features, strengths and weaknesses, good programming practices and plan your code	2
2	Working with variables, workspace and miscellaneous commands Creating MATLAB variables, overwriting variable, error messages, making corrections, controlling the hierarchy of operations or precedence, controlling the appearance of floating point number, managing the workspace, keeping track of your work session, entering multiple statements per line, miscellaneous commands	5
3	Matrix, array and basic mathematical functions Matrix generation, entering a vector, entering a matrix, matrix indexing, colon operator, linear spacing, creating a sub-matrix, dimension, matrix operations and functions matrix generators, special matrices, array and array operations, solving linear equations, other mathematical functions.	5
4	Basic plotting Overview, creating simple plots, adding titles, axis labels, and annotations, multiple data sets in one plot, specifying line styles and colours	4

5	Introduction to programming Introduction, M-File Scripts, script side-effects, M-File functions, anatomy of a M-File function, input and output arguments, input to a script file, output commands	4
6	Control flow and operators ``if ... end'' structure, relational and logical operators, ``for ... end'' loop, ``while ... end'' loop, other flow structures, operator precedence, saving output to a file	5
7	Debugging M-files Debugging process, preparing for debugging, setting breakpoints, running with breakpoints, examining values, correcting and ending debugging, correcting an M-file	5
	Total	**30**

Text Books:

1. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, *Digital Image Processing using MATLAB*, Second Edition, Pearson Education, Inc , 2004.
2. Stormy Attaway, Butterworth-Heinemann, *MATLAB: A Practical Introduction to Programming and Problem Solving*, Fourth Edition, Butterworth-Heinemann is an imprint of Elsevier, 2017.

References:

1. Clever Moler, *Experiments with Matlab*, MathWorks, Inc., 2011.

Laboratory Work

8 to 10 experiments (and a practicum where applicable) based on the syllabus

Seema Shah

Signature
(Head of the Department)

Program: B. Tech (Computer Science and Business Systems)				**Semester :** VII	
Course: Financial Management				**Code:** BTCS07003	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 50)**	**Term End Examinations (TEE) (Marks - 100)**
3	0	0	3	Marks Scaled to 50	Marks Scaled to 50

Pre-requisite: Financial & Cost Accounting

Course Objective

Students will understand the theories in corporate finance and apply the same in corporate. The computation of minimum return required to sustain in business.

Course Outcomes

After completion of the course, the student will be able to:

1. Understand the fundamental concepts of financial management
2. Appreciate basic concepts such as time value of money, cost of capital, risk and return, working capital management, capital budgeting etc.
3. Leverage the concept for deciding financial angle of IT projects

Detailed Syllabus:

Unit	Description	Duration
1	Introduction: Introduction to Financial Management - Goals of the firm - Financial Environments.	4
	Time Value of Money : Simple and Compound Interest Rates, Amortization, Computing more than once a year, Annuity Factor.	5
2	Valuation of Securities : Bond Valuation, Preferred Stock Valuation , Common Stock Valuation, Concept of Yield and YTM.	4
	Risk & Return: Defining Risk and Return, Using Probability Distributions to Measure Risk, Attitudes Toward Risk, Risk and Return in a Portfolio Context, Diversification, The Capital Asset Pricing Model (CAPM)	4
3	Operating & Financial Leverage: Operating Leverage, Financial Leverage, Total Leverage, Indifference Analysis in leverage study	4
	Cost of Capital:	5

	Concept, Computation of Specific Cost of Capital for Equity - Preference – Debt, Weighted Average Cost of Capital – Factors affecting Cost of Capital	
	Capital Budgeting: The Capital Budgeting Concept & Process - An Overview, Generating Investment Project Proposals, Estimating Project, After Tax Incremental Operating Cash Flows, Capital Budgeting Techniques, Project Evaluation and Selection - Alternative Methods	**6**
4	Working Capital Management: Overview, Working Capital Issues, Financing Current Assets (Short Term and Long Term- Mix), Combining Liability Structures and Current Asset Decisions, Estimation of Working Capital.	**5**
	Cash Management: Motives for Holding cash, Speeding Up Cash Receipts, Slowing Down Cash Payouts, Electronic Commerce, Outsourcing, Cash Balances to maintain, Factoring	**4**
	Accounts Receivable Management: Credit & Collection Policies, Analyzing the Credit Applicant, Credit References, Selecting optimum Credit period.	**4**
	Total	**45**

Text Books:

1. Chandra, Prasanna, *Financial Management - Theory & Practice*, Tata McGraw Hill.

References:

1. Srivastava, Misra, "*Financial Management*", OUP
2. Van Horne and Wachowicz, "*Fundamentals of Financial Management*", Prentice Hall, Pearson Education.

Seema Shah

Signature
(Head of the Department)

Program: B. Tech (Computer Science and Business Systems)				**Semester : VII**	
Course: Human Resource Management				**Code:** BTCS07004	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 50)**	**Term End Examinations (TEE) (Marks - 100)**
3	0	0	3	Marks Scaled to 50	Marks Scaled to 50
Pre-requisite: Introduction to Business Analytics and Business Intelligence					

Course Objective

To learn the strategic role of HRM in making organisation adaptable to changes and appreciate the role of HR managers in organisations. Students will be able to understand HR functions in organisations and the importance of teamwork

Course Outcomes

After completion of the course, the student will be able to -

1. relate to basic principles of HRM in complex business environment
2. interpret basic concepts, roles, functional areas and activities of HR
3. comprehend the importance of employee contribution in firm's current performance and sustainability in the long run

Detailed Syllabus:

Unit	Description	Duration
1	Human Resource Management: Concept and Challenges, HR Philosophy, Policies, Procedures and Practices.	**4**
2	Human Resource System Design: HR Profession, and HR Department, Line Management Responsibility in HRM, Measuring HR, Human resources accounting and audit;	**5**
3	Functional Areas of HRM: Recruitment and staffing, benefits, compensation, employee relations, HR compliance, organizational design, training and development, human resource information systems (H.R.I.S.) and payroll.	**10**
4	Human Resource Planning: Demand Forecasting, Action Plans– Retention, Training, Redeployment & Staffing, Succession Planning	**6**
5	Strategic Management of Human Resources: SHRM, relationship between HR strategy and overall corporate strategy, HR as a Factor of Competitive Advantage, Managing Diversity in the Workplace	**4**
6	Human Resource Management in Service Sector: Special considerations for Service Sector including • Managing the Customer – Employee Interaction • Employee Empowerment and Customer Satisfaction	**10**

	• Service Failure and Customer Recovery – the Role of Communication and Training • Similarities and Differences in Nature of Work for the Frontline Workers and the Backend • Support Services - Impact on HR Practices Stressing Mainly on Performance • Flexible Working Practices – Implications for HR	
	Home Assignment: Further, the topic for class discussion will be mentioned beforehand. Students are required to meet in groups before coming to class and prepare for the topic to be discussed. Instructor may ask the student groups to present their analysis and findings to the class. Few topics are mentioned below as examples. Instructor can add or change any topic as per requirement. 1. Topic: Understanding the issues and challenges involved in managing a diverse workforce 2. Topic: Is The Only Purpose of a Corporation to Maximize Profit? 3. Topic: Similarities and Differences in Manufacturing and Service Sector - Impact on HR Practices	**6**
	Total	**45**
Text Books: 1. Gary Dessler, *Human Resource Management*		
References: 1. Dave Ulrich, *Human Resource Management*, MCGraw Hill publication.		

Seema Shah

Signature
(Head of the Department)

Program: B. Tech (Computer Science and Business Systems)				**Semester: VII**	
Course : Cognitive Science & Analytics (Elective III)				**Code:** BTCS07006	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 50)**	**Term End Examinations (TEE) (Marks - 100)**
3	2	0	4	Marks Scaled to 50	Marks Scaled to 50

Pre-requisite: Introduction to Business Analytics and Business Intelligence.

Course Objective

Students will be familiar with basic concepts of cognitive and analytical learning and will be able to use them in problem solving.

The purpose of this course is to give students a broad understanding of the field of cognitive science. The course discusses models of cognition that are based on empirical studies of human behaviour and computer models of artificial intelligence. They will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information.

Course Outcomes

After completion of the course, the student will be able to:

1. Understand the concepts of analytics and areas of cognitive learning.
2. Analyse the various data and cognitive analytical techniques.
3. Apply various artificial intelligence, machine learning, deep learning approaches and methodologies in real life work.

Detailed Syllabus:

Unit	Description	Duration
1	Foundational Areas of Analytics Introduction to Analytics: Definition, Description & Evolution of Analytics, History of Analytics, and Applicability of Analytics with development of Technology and Computer, How Analytics entered mainstream Concepts of Analytics: Various overlapping concepts and fields of Analytics such as Data Mining, Machine Learning, Artificial Intelligence and Simulation Emerging Areas in Analytics: Understanding of emerging research areas of Analytics: Mathematical programming, Evolutionary computation, Simulation, Machine learning/data mining, Logic-based models, and, Combinations of categories Value Chain of Analytics: Descriptive Analytics Covering Exploratory Data Analysis & Basic of Statistics, Diagnostics Analytics: BI/Analysis, Trend, Pattern, Simultaneous Relationship, Predictive Analytics: Cause-Effect Relationship and Futuristic prediction in terms of probabilities, Continuous & Categorical Predictions, Simulation, Optimization, Multi-faceted Intelligent Technology driven Analytics combining Machine Intelligence with Human Brain Processing Abilities	7

2	Foundational Areas of Cognitive Science Introduction & Evolution of Cognitive Science: Introduction to the study of cognitive sciences, Brief history of cognitive science development and Methodological concerns in philosophy Understand Brain and Sensory Motor Information: Fundamentals of Neuro Science, Processing of sensory information in the brain, and Brain Imaging Elements Language & Linguistic Knowledge: Background and details of Syntax & Semantics, Understanding of Generative Linguistic Memory & Processing: Theory of Information Processing, Fundamentals of Short term Memory	4
3	Data Theory & Taxonomy Of Data Data as a whole: Understanding of Data as a whole for distinguishing and relating various types of data and Categorization of Data: Structured, Unstructured Data, Quantitative & Qualitative Data Views of Data: Understanding Data as an interdisciplinary framework for learning methodologies: covering statistics, neural networks, and fuzzy logic Measurement & Scaling Concepts: Measurement of variables and commonly used statistical tools: Number of procedures for measurement of the variables, Categorization procedures, Scale construction procedures and Techniques of data processing for qualitative as well as quantitative data; Various types of Scales: Nominal, Ordinal, Interval & Ratio Scales	5
4	Multivariate Data Analytics & Cognitive Analytics Overview: High level overview of Categorization of Techniques: Inter-dependence Relationship Techniques and Dependence Relationship Techniques Overview of Commonly Used Inter-dependence Techniques: Factor Analysis, Principal Component Analysis (PCA), Cluster Analysis Overview of Commonly Used Dependence Techniques: Regression, Logistic Regression Analytics Value Chain & Application of Analytics across Value Chain: Basic statistical concepts such as Descriptive & Diagnostics statistics, concept of random variables, discrete and continuous random variables, confidence interval, hypothesis testing, analysis of variance and correlation. Predictive analytics techniques such as multiple linear regression, logistic regression, decision tree learning Clustering and forecasting techniques. Prescriptive analytics Concepts: linear programming, integer programming, goal programming & stochastic models ,Cognitive analytics Concepts: Text Analytics, Learning Analytics, Data Mining, Cognitive Systems, Cognitive Computing, Learning Data Science, Machine Learning, Big data Analytics and Business analytics	8
5	Artificial Intelligence & Machine Learning Fundamentals of Artificial Intelligence: Various areas of AI: Knowledge: Text Analytics, Topic Modelling, Natural Language Processing (NLP), Natural Language Generation (NLG), Natural Language Understanding (NLU), Named-entity recognition (NER)	6

	Perception: Image Analytics, Video Analytics & Audio Analytics Memory: Cognitive Engagement: BOTs, Virtual & Digital Assistants, Augmented Reality, Virtual Reality, Mixed Reality Learning: Intelligent Automation Spectrum of AI Reactive Machine: Low memory, works on Known rules, such as Object Detection/Games/Recommendations specific to known Rules Limited Memory: Memory used to learn and improve continuously such as Most ML Models, Automated VehiclesTheory of Mind: Machine Understands and responds such as BoTs/Virtual/Digital Assistants Self-Aware: Human like intelligence such as Super Robots in Space etc	
6	Approach & Methodology: World Standard Methodology: CRISP-DM Methodology, SEMMA Methodology Real Life Work around Multi-Variate Analytics: A few Selected Commonly used Techniques: Predictive & Classification Models, Regression, Clustering Real Life Work around Artificial Intelligence, Machine Learning and Deep Learning: A few Selected Commonly used Techniques & Algorithms: ANN (Artificial Neural Network), CNN (Convolutional Neural Network), RNN (Recurrent Neural Network) RN Architecture: LSTM, Bidirectional LSTM, Gated Recurrent Unit (GRU), CTRNN (Continuous Time RNN) CNN Architectures: VGG16, Alexnet, InceptionNet, RestNet, Googlenet Object Detection models: R-CNN, Fast R-CNN, Faster R-CNN, cascade R-CNN. Mask RCNN, Single Shot MultiBox Detector (SSD) ,You Only Look Once (YOLO), Single-Shot Refinement Neural Network for Object Detection (RefineDet), Retina-Net Autoencoders: Denoising Autoencoder, GAN Transformers: Attention based Encoder and Decoder: Eg- BERT(Bidirectional Encoder Representations from Transformers), Generative Pretrained Transformers GPT-3, GPT-2, BERT, XLNet, and RoBERTa	15
		45

Text Books:

Unit 1

1. Hall, P., Phan, W., & Whitson, K. (2016). Evolution of Analytics. O'Reilly Media Incorporated.

Unit 2

1. José Luis Bermúdez , Cognitive Science: An Introduction to the Science of the Mind
2. Judith S. Hurwitz (Author), Marcia Kaufman (Author), Adrian Bowles (Author) Cognitive Computing and Big Data Analytics
3. Gurumoorthy, Sasikumar, Rao, B Narendrakumar, Gao, Xiao-Zhi Cognitive Science and Artificial Intelligence Advances and Applications

Unit 3

1. Cherkassky, V., & Mulier, F. M. (2007). Learning from data: concepts, theory, and methods. John Wiley & Sons.
2. The visual display of Quantitative Information: Edward Tufte, Graphics Press, 2001.

3. Krunal D. Gulkari, Hemant V. Borate , Mayur S. Shitap Scaling Measurement and Statistical Tools for Extension Workers , 2016.

Unit 4

1. Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. (1998). Multivariate data analysis. Englewood Cliff. New Jersey, USA, 5(3), 207-2019.
2. Kumar, U. D. (2017). Business analytics: The science of data-driven decision making. Wiley.
3. Özköse, H., Arı, E. S., & Gencer, C. (2015). Yesterday, today and tomorrow of big data. Procedia-Social and Behavioral Sciences, 195, 1042-1050.
4. Gudivada, Venkat N., M. T. Irfan, E. Fathi, and D. L. Rao. "Cognitive analytics: Going beyond big data analytics and machine learning." In Handbook of statistics, vol. 35, pp. 169-205. Elsevier, 2016.

Unit 5

1. Kao, A., & Poteet, S. R. (Eds.). (2007). Natural language processing and text mining. Springer Science & Business Media.
2. Prashant Kikani , Demystifying Artificial intelligence: Simplified AI and Machine Learning concepts for Everyone (English Edition), January 2021
3. Kelleher, J. D., Mac Namee, B., & D'arcy, A. (2020). Fundamentals of machine learning for predictive data analytics: algorithms, worked examples, and case studies. MIT press.
4. Goodfellow, Ian, Yoshua Bengio, Aaron Courville, and Yoshua Bengio. Deep learning. Vol. 1, no. 2. Cambridge: MIT press, 2016.
5. Practical Deep Learning for Cloud, Mobile, and Edge: Real-World AI & Computer-Vision Projects Using Python, Keras & TensorFlow 1st Edition,
6. Conversational Chatbots for Analytics Third Edition by Gerardus Blokdyk
7. BORNET, P. B. (2020). Intelligent automation: Welcome to the world of hyperautomation. World Scientific Publishing Company.

Unit 6:

1. Maimon, O., & Rokach, L. (Eds.). (2005). Data mining and knowledge discovery handbook.
2. Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. (1998). Multivariate data analysis. Englewood Cliff. New Jersey, USA, 5(3), 207-2019.
3. Zhang, C., & Ma, Y. (Eds.). (2012). Ensemble machine learning: methods and applications. Springer Science & Business Media.

Reference Books

Unit 1

Seminal Paper: The evolution of analytics and implications for industry and academic programs MR Bowers, JD Camm, G Chakraborty - Interfaces, 2018 - pubsonline.informs.org.

Unit 2

Cognitive Analytics: Concepts, Methodologies, Tools, and Applications (4 Volumes) Information Resources Management Association (USA)A first course in Probability, S. M. Ross, Prentice Hall.

Unit 3

Seminal paper: Shneiderman, B. (2003). The eyes have it: A task by data type taxonomy for information visualizations. In The craft of information visualization (pp. 364-371). Morgan Kaufmann.C: The Complete Reference, (Fourth Edition), Herbert Schildt, McGraw Hill.

Laboratory Work

8 to 10 experiments (and a practicum where applicable) based on the syllabus

Note: Highlighted topics are to be covered in tutorial session.

Signature
(Head of the Department)

Program: B. Tech (Computer Science & Business Systems)				**Semester:** VII	
Course : Introduction to IoT (Elective III)				**Code:** BTCS07007	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 50)**	**Term End Examinations (TEE) (Marks - 100)**
3	2	0	4	Marks Scaled to 50	Marks Scaled to 50

Pre-requisite: Computer Networks, Operating Systems , Computer Organization and Architecture

Course Objective

This course will help students to understand basic principles and concepts of Internet-of-Things use cases, applications, architecture and technologies. It will help them to get an overview of an end to end IoT system encompassing the edge, cloud and application tiers and assist the to create an end-to-end IoT application.

Course Outcomes

After completion of the course, the student will be able to:

1. Identify the components, techniques and frameworks for IoT
2. Analyse the processes and design methodology for IoT networking and communication
3. Demonstrate the various techniques of IoT data processing and applications

Detailed Syllabus:

Unit	Description	Duration
1	Introduction to IoT and Use cases: Understanding basic concepts of IoT, Consumer IoT vs Industrial Internet, Fundamental building blocks, Use Cases of IoT in various industry domains	**07**
2	Architecture: IoT reference architectures, Industrial Internet Reference Architecture, Edge Computing, IoT Gateways, Data Ingestion and Data Processing Pipelines, Data Stream Processing	**09**
3	Sensors and Industrial Systems: Introduction to sensors and transducers, integrating sensors to sensor processing boards, introduction to industrial data acquisition systems, industrial control systems and their function	**09**
4	Networking and Communication for IoT: Recap of OSI 7 layer architecture and mapping to IoT architecture, Introduction to proximity networking technologies (ZigBee, Bluetooth, Serial Communication), Industrial network protocols (Modbus, CANbus), Communicating with cloud applications (web services, REST, TCP/IP and UDP/IP sockets, MQTT, WebSockets, protocols. Message encoding (JSON, Protocol Buffers)	**11**
5	IoT Data Processing and Storage:	**09**

	Time Series Data and their characteristics, time series databases, basic time series analytics, data summarization and sketching, dealing with noisy and missing data, anomaly and outlier detection	
	Total	**45**

Text Books:

1. The Internet of Things, Samuel Greengard, MIT Press Essential Knowledge Series
2. Vijay Madisetti and Arshdeep Bahga, Internet of Things : A Hands-on-Approach , 1st Edition, 2015

References:

1. Visualizing Data-Exploring and Explaining Data with the Processing Environment, By Ben Fry, Publisher: O'Reilly Media
2. Raspberry Pi Computer Architecture Essentials, by Andrew K Dennis
3. Getting Started with Arduino, M. Banzi, O Reilly Media

Internet references:

1. Industrial Internet Reference Architecture - http://www.iiconsortium.org/IIRA.htm
2. World Economic Forum Report on Industrial Internet of Things - https://www.weforum.org/reports/industrial-internet-things
3. 50 Sensor Applications for a Smarter World - http://www.libelium.com/resources/top_50_iot_sensor_applications_ranking/
4. GSMA IoT Security Guidelines & Assessment - https://www.gsma.com/iot/future-iot-networks/iot-security-guidelines/

Laboratory Work

8 to 10 experiments (and a practicum where applicable) based on the syllabus

Signature
(Head of the Department)

Program: B. Tech (Computer Science & Business Systems)				**Semester :** VII	
Course: Cryptology (Elective III)				**Code:** BTCS07008	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 50)**	**Term End Examinations (TEE) (Marks - 100)**
3	2	0	4	Marks Scaled to 50	Marks Scaled to 50

Pre-requisite: Fundamentals of Computer Science, Computer Networks

Course Objective

To provide fundamental knowledge on Cryptology.

Course Outcomes

After completion of the course, the student will be able to-

1. Understand the basic concepts of cryptography and security services.
2. Discuss Symmetric key cryptosystems and public key cryptosystems
3. Describe security applications.
4. Analyse post quantum cryptography

Detailed Syllabus:

Unit	Description	Duration
1.	Introduction to Cryptography: Elementary number theory, Pseudo-random bit generation, Elementary cryptosystems.	7
2.	Basic security services: Confidentiality, integrity, availability, non-repudiation, privacy	6
3.	Symmetric key cryptosystems: Stream Cipher: Basic Ideas, Hardware and Software Implementations, Examples with some prominent ciphers: A5/1, Grain family, RC4, Salsa and ChaCha, HC128, SNOW family, ZUC; Block Ciphers: DES, AES, Modes of Operation; Hash Functions; Authentication	12
4.	Public Key Cryptosystems: RSA, ECC; Digital signatures	6
5.	Security Applications (Selected Topics): Electronic commerce (anonymous cash, micro-payments), Key management, Zero-knowledge protocols, Cryptology in Contact Tracing Applications, Issues related to Quantum Cryptanalysis	8
6.	Introductory topics in Post-Quantum Cryptography: Any two ciphers in post quantum cryptography	6
	Total	**45**

Text Books:

1. D. R. Stinson, *Cryptography, Theory and Practice*. CRC Press.
2. A. J. Menezes, P. C. van Oorschot, and S. A. Vanstone, *Handbook of Applied Cryptography*. CRC Press.

References:

1. A course in number theory and cryptography. N. Koblitz:, GTM, Springer.
2. Cryptography and Network Security. W. Stallings, Prentice Hall.
3. Security Engineering, R. Anderson, Wiley
4. RC4 Stream Cipher and Its Variants. G. Paul and S. Maitra: CRC Press, Taylor
5. & Francis Group, A Chapman & Hall Book, 2012
6. Design & Cryptanalysis of ZUC - A Stream Cipher in Mobile Telephony. C. S. Mukherjee, D. Roy, S. Maitra, Springer 2020
7. Contact Tracing in Post-Covid World - A Cryptologic Approach. P. Chakraborty, S. Maitra, M. Nandi, S. Talnikar, Springer 2020
8. Presskil Lecture notes: Available online: http://www.theory.caltech.edu/~preskill/ph229/

Internet reference: https://csrc.nist.gov/projects/post-quantum-cryptography.

Laboratory Work

8 to 10 experiments (and a practicum where applicable) based on the syllabus

Seema Shah

Signature
(Head of the Department)

Program: B. Tech (Computer Science and Business Systems)				**Semester:** VII	
Course : Quantum Computation & Quantum Information (Elective IV)				**Code:** BTCS07009	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 50)**	**Term End Examinations (TEE) (Marks - 100)**
3	2	0	4	Marks Scaled to 50	Marks Scaled to 50
Pre-requisite : Discrete Mathematics, Linear Algebra					

Course Objective

This course provides an introduction to the theory and practice of quantum computation. Topics covered include: physics of information processing, quantum logic, quantum algorithms including Shor's factoring algorithm and Grover's search algorithm, quantum error correction, quantum communication, and cryptography.

Course Outcomes

After completion of the course, the student will be able to -

1. Describe States, Operators, Measurements in Quantum computing.
2. Implement and apply Quantum Algorithms in real world problems.
3. Apply Quantum True Random Number Generators and Quantum key distribution (QKD) in real world problem.
4. Review the topics from Post-Quantum Cryptography.

Detailed Syllabus:

Unit	Description	Duration
1	Introduction to Quantum Information: States, Operators, Measurements, Quantum Entanglement: Quantum Teleportation, Super-dense coding, CHSH Game, Quantum gates and circuits	**8**
2	Quantum Algorithms: Deutsch-Jozsa, Simon, Grover, Shor, Implication of Grover's and Simon's algorithms towards classical symmetric key cryptosystems, Implication of Shor's algorithm towards factorization and Discrete Logarithm based classical public key cryptosystems	**15**
3	Quantum True Random Number Generators (QTRNG): Detailed design and issues of quantumness, Commercial products and applications	**8**
4	Quantum key distribution (QKD): BB84, Ekert, Semi-Quantum QKD protocols and their variations, Issues of Device Independence, Commercial products	**7**
5	Introductory topics in Post-Quantum Cryptography: Refer to https://csrc.nist.gov/projects/post-quantum-cryptography. May discuss any two ciphers from this list.	**7**

	Total	**45**

Text Books and Links:

1. M. A. Nielsen and I. L. Chuang, *Quantum Computation and Quantum Information*. Cambridge University Press (First Edition), 23 October 2000.
2. Presskil Lecture notes, Available online: http://www.theory.caltech.edu/~preskill/ph229/

References:

1. P. Kaye, R. Laflamme, and M. Mosca, *An Introduction to Quantum Computing*., (First Edition 2006), Oxford University Press New York
2. N. David Mermin, *Quantum Computer Science*. Cambridge University Press, June 2012
3. Alfred J. Menezes, Paul C. van Oorschot, Scott A. Vanstone, *Handbook of Applied Cryptography*. (Fifth edition), CRC Press, 2001

Internet references:

1. D. Unruh, Quantum Cryptography. Available online: retrieved from: https://courses.cs.ut.ee/all/MTAT.07.024/2017_fall/uploads/
2. NIST Post Quantum Cryptography, Available online: https://csrc.nist.gov/projects/post-quantum-cryptography/round-2-submissions
3. SAPV Tharrmashastha, D. Bera, A. Maitra and S. Maitra, Quantum Algorithms for Cryptographically Significant Boolean Functions - An IBMQ Experience., Springer 2020 (First Edition).
4. Quantum Algorithm Zoo. Retrieved from: https://quantumalgorithmzoo.org/

Laboratory Work

8 to 10 experiments (and a practicum where applicable) based on the syllabus

Signature
(Head of the Department)

Program: B. Tech (Computer Science and Business Systems)				**Semester:** VII	
Course: Advanced Social, Text and Media Analytics (Elective IV)				**Code:** BTCS07010	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 50)**	**Term End Examinations (TEE) (Marks - 100)**
3	2	0	4	Marks Scaled to 50	Marks Scaled to 50

Pre-requisite: Data Mining, Machine Learning, Python Programming

Course Objective

The objective of this course is to impart knowledge of Application Programming Interface (API) services to collect data and analyze structures or unstructured data - primarily textual comments - for sentiments expressed in them. To Use different tools for collecting, analyzing, and exploring social media data for research and development purposes.

Course Outcomes

After completion of the course, the student will be able to -

1. Understand various techniques for Text Mining and carry out Pattern Discovery, Predictive Modelling
2. Explore the use of social network analysis to understand the growing connectivity and complexity in the world around us on different scales – ranging from small groups to the World Wide Web
3. Develop social network analysis model to identify important social actors, subgroups (i.e., clusters), and network properties in social media sites such as Twitter, Facebook, and YouTube

Detailed Syllabus:

Unit	Description	Duration
1	Text Mining: Introduction, Core text mining operations, Pre-processing techniques, Categorization, Clustering, Information extraction, Probabilistic models for information extraction, Text mining applications	9
	Methods & Approaches: Content Analysis; Natural Language Processing; Clustering & Topic Detection; Simple Predictive Modeling; Sentiment Analysis; Sentiment Prediction	12
2	Web Analytics: Web analytics tools, Clickstream analysis, A/B testing, online surveys; Web search and retrieval, Search engine optimization, Web crawling and Indexing, Ranking algorithms, Web traffic models	12

3	Social Media Analytics: Social network and web data and methods. Graphs and Matrices. Basic measures for individuals and networks. Information visualization; Making connections: Link analysis. Random graphs and network evolution. Social contexts: Affiliation and identity; Social network analysis	**12**
	Total	**45**

Text Books:

1. Ronen Feldman and James Sanger, *The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data*, Cambridge University Press, 2006.
2. Hansen, Derek, Ben Sheiderman, Marc Smith. 2011 Analyzing Social Media Networks with NodeXL: Insights from a Connected World, Morgan Kaufmann, 304
3. Avinash Kaushik. 2009. Web Analytics 2.0: The Art of Online Accountability.
4. Hanneman, Robert and Mark Riddle. 2005. Introduction to Social Network Method

References:

1. Wasserman, S. & Faust, K. (1994). Social network analysis: Methods and applications. New York: Cambridge University Press.
2. Monge, P. R. & Contractor, N. S. (2003). Theories of communication networks. New York: Oxford University Press. http://nosh.northwestern.edu/vita.htm

Laboratory Work

8 to 10 experiments (and a practicum where applicable) based on the syllabus

Signature
(Head of the Department)

Program: B. Tech (Computer Science and Business Systems)				**Semester: VII**	
Course: Mobile Computing (Elective IV)				**Code:** MBCO06002	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 50)**	**Term End Examinations (TEE) (Marks - 100)**
3	2	0	4	Marks Scaled to 50	Marks Scaled to 50

Pre-requisite:
Operating Systems, Object Oriented Programming and Computer Networks

Course Objective
To educate students with wide knowledge in Mobile Computing

Course Outcomes
After completion of the course, the student will be able to -

1. Describe the mobile computing architecture and applications.
2. Compare location and handoff techniques.
3. Analyse wireless transmission networks and assess mobile ad-hoc, WSNs and cognitive radio networks.
4. Identify issues related to recent communication technologies for cellular network i.e. 5G network.

Detailed Syllabus:

Unit	Description	Duration
1	Introduction: Overview of wireless and mobile infrastructure; Preliminary concepts on cellular architecture; Design objectives and performance issues; Radio resource management and interface; Propagation and path loss models; Channel interference and frequency reuse; Cell splitting; Channel assignment strategies; Overview of generations:- 1G to 5G.	**7**
2	Location and handoff management: Introduction to location management (HLR and VLR); Mobility models characterizing individual node movement (Random walk, Fluid flow, Markovian, Activity based); Mobility models characterizing the movement of groups of nodes (Reference point based group mobility model, Community based group mobility model); Static (Always vs. Never update, Reporting Cells, Location Areas) and Dynamic location management schemes (Time, Movement, Distance, Profile Based); Terminal Paging (Simultaneous paging, Sequential paging); Location management and Mobile IP; Overview of handoff process; Factors affecting handoffs and performance evaluation metrics; Handoff strategies; Different types of handoffs (soft, hard, horizontal, vertical)	**12**

3	Wireless transmission fundamentals: Introduction to narrow and wideband systems; Spread spectrum; Frequency hopping; Introduction to MIMO; MIMO Channel Capacity and diversity gain; Introduction to OFDM; MIMO-OFDM system; Multiple access control (FDMA, TDMA, CDMA, SDMA); Wireless local area network; Wireless personal area network (Bluetooth and ZigBee)	**6**
4	Mobile Ad-hoc networks: Characteristics and applications; Coverage and connectivity problems; Routing in MANETs.	**4**
	Wireless sensor networks: Concepts, basic architecture, design objectives and applications; Sensing and communication range; Coverage and connectivity; Sensor placement; Data relaying and aggregation; Energy consumption; Clustering of sensors; Energy efficient Routing (LEACH).	**7**
	Cognitive radio networks: Fixed and dynamic spectrum access; Direct and indirect spectrum sensing; Spectrum sharing; Interoperability and co-existence issues; Applications of cognitive radio networks.	**4**
5	D2D communications in 5G cellular networks: Introduction to D2D communications; High level requirements for 5G architecture; Introduction to the radio resource management, power control and mode selection problems; Millimeter wave communication in 5G.	**5**
	Total	**45**

Text Books:

1. Jochen Schiller, *Mobile Communications*, 2nd edition, Pearson Education, 2008.
2. Andrea Goldsmith, *Wireless Communications*, 1st edition, Cambridge University Press, 2005.

References:

1. Theodore Rappaport , *Wireless Communications: Principles and Practice*, 2nd edition, Pearson Education, 2002.
2. Ezio Biglieri , *Wireless Communications*, MIMO, 1st edition, Cambridge University Press, 2007.
3. Ivan Stojmenovic, *Handbook of Wireless Networking and Mobile Computing*, 1st edition, Wiley, 2002.
4. Dynamic Location Management in Heterogeneous Cellular Networks. James Cowling,
5. MIT Thesis. http://people.csail.mit.edu/cowling/hons/jcowling-dynamic-Nov04.pdf
6. Location Management in Wireless Cellular Networks. Travis Keshav, https://www.cse.wustl.edu/~jain/cse574-06/ftp/cellular_location.pdf
7. Location Management in Wireless Data Networks. Fahd A. Batayneh, https://www.cse.wustl.edu/~jain/cse574-06/ftp/wireless_location.pdf
8. Principles of Mobile Communication. Gordon L. Stber, Springer.

9. Wireless Device-to- Device Communications and Networks. Lingyang Song, Dusit Niyato, Zhu Han, and Ekram Hossain, Cambridge University Press.
10. Principles of Cognitive Radio. Ezio Biglieri, Andrea J. Goldsmith, Larry J. Greenstein, Narayan Mandayam and H. Vincent Poor, Cambridge University Press.
11. Wireless Sensor Networks: Architectures and Protocols. Edgar H. Callaway, Jr. and Edgar H. Callaway, CRC Press.
12. A Discrete-Event Network Simulator. https://www.nsnam.org/docs/manual/html/index.html

Laboratory Work

8 to 10 experiments (and a practicum where applicable) based on the syllabus

Development and implementation of different network protocols using network simulators such as NS-3 and OMNET++.

Signature
(Head of the Department)

Program:	B Tech (Computer Science and Business Systems)			**Semester :** VII	
Course :	Project Evaluation - I			**Code:** BTCS07005	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorial Hours per week**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 50)**	**Term End Examinations (TEE) (Marks - 100)**
0	2	0	1	Marks Scaled to 100	-

Pre-requisite: Courses covered in the earlier semesters which impart knowledge of Problem Identification, Definition, Analysis, Design and Implementation of various tools and technologies.

Course Objective

This course prepares students to learn research and develop, self-learning attitude and working skills through software project development. Also, students can prepare the project report using standard practices.

Course Outcomes

After successful completion of the course, the student will be able to

1. Understand the problem statement in the chosen domain.
2. Analyze the problem in hand by conducting Literature Survey.
3. Design solutions for the problems identified.
4. Present solutions of problem identified and generate relevant documentation.

Detailed Syllabus:

A group of 3-4 students selects the problem definition for the project work discussed and finalized with the help of faculty mentor. They are required to develop a project based on three- tier (Front end, logic development, Database) architecture.

Evaluation:

Each group is expected to maintain the log book. The log book needs to be evaluated by the mentor every week as the part of continuous evaluation. Each group must demonstrate the working project, submit the report and do the ppt presentation at the end of the semester as the part of semester end exam. The exam can be taken by two examiners: one internal and one external examiner.

Project Report must contain:

1. Problem Definition
2. Originality of the work/Plagiarism declaration
3. Project description
4. Details of development – Methods / Techniques / Data / Charts / Diagrams
5. Database design
6. Applications – Advantages and Limitations.
7. Project Code & Snapshots/Output
8. Future scope
9. References.

Term Work: Details of Internal Continuous Assessment (ICA)

Evaluation Phases	**Evaluation**	**Marks**
Weekly Log book	Weekly progress report	20
Midterm Evaluation	Presentation / Viva and Report	30
Final	Presentation / Viva and Report	50
Total Marks		100

Signature
(Head of the Department)