8th SEMESTER							
THEORY#							
SL. NO.	PAPER CODE	PAPER NAME	L	T	P	CONTACT HRS./WEEK	CREDIT
01	PEC(IT)805	Elective-V	3	0	0	3	3
02	OEC(IT/CS)803	Open Elective-III	3	0	0	3	3
PRACTICAL							
01	PROJ(IT)803	Project 3	0	0	16	16	8
SESSIONAL							
01	CVV(IT)802	Comprehensive Viva Voce	0	0	0	0	1
TOTAL			6	0	16	22	15

PEC(IT)805
A: E-Commerce
B: Data Mining
C: Mobile Communication
D: Internet of Things
E: Data Science

OEC(IT/CS)803
A: Image Processing
B: Software Project Management
C: Social Network Analysis
D: Quantum Computing
E: Bioinformatics

Name of the course	**E-Commerce**
Course Code: PEC(IT)805A	**Semester: 8th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Mid Term I: 15 Marks
Credit Points: 3	Mid Term II: 15 Marks
	Assignments, Test based on assignments, Quizzes, Presentations, Attendance etc. : 20 Marks
	End Semester Exam: 50 Marks

Objective:	
1.	To apply basic design tools & techniques for developing E-Commerce application.
2.	To recognize the underlying architecture of E-Commerce applications.
3.	To solve the common E-commerce site design and maintenance problems.
Pre-Requisite	
1.	Object Oriented Methodology PC(CS/IT)513
2.	Database Management System PC(CS/IT)512
3.	Web Technology PEC(IT)704A

Unit	Content	Hrs	Marks
1	**Introduction to E-Commerce** Definition, Scope of E-Commerce, Hardware requirements, Ecommerce and Trade Cycle, Electronic Markets, Internet Commerce.	4	
2	**Business to Business E-Commerce** Electronic Data Interchange (EDI): Technology, Standards (UN/EDIFACT), Communications, Implementations, Agreements, Security, EDI and Business, Inter-Organizational E-commerce.	6	
3	**Legal issues** Risks: Paper Document vs. Electronic document, Authentication of Electronic document, Laws, Legal issues for Internet Commerce: Trademarks and Domain names, Copyright, Jurisdiction issues, Service provider liability, Enforceable online contract.	5	
4	**Security Issues** Security Solutions: Symmetric and Asymmetric Cryptosystems, Digital Signature, Protocols for secure messaging, Secure Electronic Transaction (SET) Protocol, Financial transactions over internet, Internet Security.	6	
5	**Business to Consumer E-Commerce** Consumer trade transaction, Internet, Page on the Web, Elements of E-Commerce with case studies.	8	
6	**E-business** Internet bookshops, Software supplies and support, Electronic	7	

	Newspapers, Internet Banking, E Auctions, Online Share Dealing, E-Diversity with Case studies.		

Text Book(s):

1. E-Commerce-Strategy, Technologies & Applications by David Whitley, TMH
2. E-Commerce- The cutting edge of business by Kamlesh K. Bajaj, TMH

Reference Book(s):

1. Global Electronic Commerce- Theory and Case Studies by J. Christopher Westland and Theodore H. K Clark, University Press

Course Outcomess

After completion of the course the students will be able to-

CO1: Differentiate among various types of module development technologies related to E-Commerce applications.

CO2: Design the module of any E-Commerce application with the help of associated technologies.

CO3: Apply the skills related to various types of E-Commerce sites in the implementation of E-Commerce module.

CO4: Apply the knowledge of E-Commerce security and legal issues.

Name of the course	**Data Mining**
Course Code: PEC(IT)805B	**Semester: 8th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Mid Term I: 15 Marks
Credit Points: 3	Mid Term II: 15 Marks
	Assignments, Test based on assignments, Surprise tests, Quizzes, Presentations, Attendance etc. : 20 Marks
	End Semester Exam: 50 Marks

Objective:	
1.	To understand the principles of Data warehousing and Data Mining.
2.	To be familiar with the Data warehouse architecture and its Implementation.
3.	To know the Architecture of a Data Mining system.
4.	To understand the various Data preprocessing Methods.
5.	To understand and apply various Classification and Clustering techniques using tools.
6.	To know the Association Rule Mining.
7.	To understand various Web Mining techniques.
Pre-Requisite	
1.	DBMS [PC(CS/IT)512]

2.	High School level Statistics		
Unit	Content	Hrs	Marks
1	Data Warehousing: Define Data Warehouse, The building blocks of a Data warehouse, Warehouse Schema, Data Warehouse Architecture, Infrastructure and Metadata Management, Data Marts, ETL, OLAP, MOLAP.	4	
2	Introduction of Data Mining: Basics of data mining, related concepts, Data mining techniques, The KDD processes, Data Preprocessing – Cleaning, Integration, Reduction, Transformation and discretization.	3	
3	Classification Algorithms: Define Classification, Supervised Learning, Classifier Accuracy, Decision Tree and Naïve Bayes Classifier.	6	
4	Clustering: Define clustering, Types of data, Partitioning Methods (K-Means, K-Medoids), PAM, CLARA, CLARANS, Hierarchical Methods (Agglomerative, Divisive), Distance and similarity Function.	10	
5	Association rules: Define Association Rule mining, Market Basket Analysis, Apriori Algorithm, FP tree Algorithm, Iceberg Queries. Advanced Association Rules (concepts only). Applications of Data Mining.	9	
6.	Web Mining: Web Content Mining, Web Structure Mining, Web Usage Mining	4	

Text Book(s):

1. Jiawei Han, Micheline Kamber and Jian Pei “Data Mining Concepts and Techniques”, Third Edition, Elsevier, 2011.
2. Data Mining Techniques, Arun K Pujari, 3rd Edition, Universities Press.

Reference Book(s):

1. Introduction to Data Mining, Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, Pearson Education.
2. Alex Berson and Stephen Smith, Data Warehousing, Data Mining and OLAP, Tata McGraw – Hill Edition, 35th Reprint 2016.
3. K.P. Soman, Shyam Diwakar and V. Ajay “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2006.
4. G. K. Gupta “Introduction to Data Mining with Case Studies”, Easter Economy Edition, Prentice Hall of India, 2006.
5.Pang-Ning Tan, Michael Steinbach and Vipin Kumar “Introduction to Data Mining”, Pearson Education, 2007.
6. Data Ware Housing Fundamentals, Pualraj Ponnaiah, Wiley Student Edition.

Course Outcomes:

After completion of the course the students will be able to-

1. Implement Data warehouse system and perform business analysis with OLAP tools.
2. Apply suitable pre-processing and visualization techniques for data analysis.
3. Identify appropriate classification and clustering techniques for data analysis.
4. Apply frequent pattern and association rule mining techniques for data analysis.
5. Explain Web mining techniques.

Name of the course	**Mobile Communication**
Course Code: PEC(IT)805C	**Semester: 8th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Two Mid term Exams: 30 Marks
Credit Points: 3	Assignment & Quiz: 10 Marks
	Term paper, Presentation on selected topics: 10 Marks
	End Semester Exam: 50 Marks

Objective:	
1.	To study the concept of mobile communication and evolution of mobile network
2.	To understand cellular concepts and improvements cell capacity
3.	To study wireless network and different protocol in physical and data link layer
4.	To be familiar with mobile IP and mobile TCP
5.	To study mobile routing and mobile security

Pre-Requisite			
1.	Computer Networks [PC(CS/IT)617]		
Unit	Content	Hrs	Marks
1	**Introduction:** A General Overview: History of wireless communication, Multiplexing, Multiple Access basics and Different generations of Cellular Telephony: GSM, GPRS, CDMA2000, UMTs, LTE	6	17
2	**Cellular Networks:** Cellular Concept, Frequency Reuse, Channel Allocation Management, Call Setup, Location Management, Cell Handoffs; Interference: Co-channel and Adjacent Interference. System Capacity, Improving Cell Capacity and Coverage: Cell Splitting, Sectoring, Repeaters and Microcell Zone Concept.	7	19
3	**Wireless Networks:** Infrastructure and ad-hoc network, IEEE 802.11: System and Protocol Architecture, Physical and MAC Layer. Media Access Techniques – ALOHA, CSMA. Bluetooth: Architecture, Radio Layer, Baseband Layer, Link Management Protocol, L2CAP and Security. Wi-Fi and WiMax.	8	22
4	**Mobile Network Layer:** Mobile IP, IP Packet Delivery, Agent Discovery, Registration, Tunnelling and Encapsulation, Optimizations and Reverse Tunnelling, Ad-hoc network, Proactive and reactive routing	6	17
5	**Mobile Transport Layer:** Introduction, Traditional TCP: Congestion Control, Slow Start, Fast Retransmit and Implications of Mobility. Classical TCP Improvements: Indirect TCP, Snooping TCP, Mobile	6	17

	TCP and Fast Retransmit/fast recovery.		
6	**Mobile Security:** Threats, Vulnerabilities, Attacks, Integrity, Confidentiality, malware, Policies.	3	8

Text Book(s):

[1] J. Schiller, Mobile Communications, Addison –Wesley

[2] T. S. Rapport, Wireless Communications, Principle and Practices

Reference Book(s):

[1] Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, Principles of Mobile Computing, Springer

[2] W.C.Y. Lee - Mobile Cellular Communications, 2nd Edition, MC Graw Hill.

Course Outcomes:

After completion of this course students will be able to-

1. Compare different mobile communication technologies and evolution of mobile network
1. Illustrate different methodologies for improving cell capacity in cellular network
2. Analyze different wireless communications and access techniques
4. Illustrate MobileIP and different routing models for ad hoc network
5. Assess different transport layer protocols in mobile communication
5. Analyze threats and vulnerabilities in mobile network and relate different security policies.

Name of the course	**Internet of Things**
Course Code: PEC(IT)805D	**Semester: 8th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Mid Term I Exam: 15 Marks
Credit Points: 3	Mid Term II Exam: 15 Marks
	Assignments, Quiz, Presentation & Attendance: 20 Marks
	End Semester Exam & Viva: 50 Marks

Objective:

1.	To learn fundamentals, genesis, Internet principles and architectures of IoT
2.	Illustrate diverse methods of deploying smart objects and connect them to network.
3.	To understand prototyping embedded devices for sensing real world entities
4.	To gain an understanding of the role of Application protocols and Security in IoT

Pre-Requisite:

1.	Computer Networks [PC(CS/IT)617]

Unit	Content	Hrs	Marks
1	**The Internet of Things:** An Overview, Genesis of IoT, Impact,	8	

	challenges, The Technology of the Internet of Things, Internet Principles: Traditional Internet Review, HTTP, HTTPS, AMQP, SIP; Overview of the Architecture of an IP-based Internet of Things: Physical/Link Layer, Low-power Wi-Fi, Bluetooth, Powerline Communications, Network and higher Layers		
2	**IoT Network Architecture and Design:** Drivers Behind New Network Architectures, IoT Architectures: The IoT World Forum (IoTWF) Standardized Architecture, IT and OT Responsibilities in the IoT Reference Model, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack: Fog Computing, Edge Computing, The Hierarchy of Edge, Fog, and Cloud	10	
3	**Prototyping Embedded Devices:** Sensors, Actuators, Micro-Electro-Mechanical Systems (MEMS) and Smart Objects, Wireless Sensor Network and its communication protocol, Machine to Machine Communication, Introduction to Arduino and Raspberry Pi	6	
4	**Interoperability:** Interoperability in Internet of Things, Cloud-based Solutions, REST and TheWeb of Things, IoT Access Technologies: IEEE 802.15.4; Optimizing IP for IoT: 6LoWPAN	6	
5	**Application Protocols and Security in the IoT:** IoT network management sublayer: CoAP, MQTT; Security Issues in the IoT**,** Security Mechanisms Overview: Traditional vs Lightweight security, Lightweight Cryptography, Authorization Mechanisms for Secure IoT Services	6	

Text Book(s):

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Pearson Education
2. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", Wiely,

Reference Book(s):

1. Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri, "Internet of Things: Architectures, Protocols and Standards", John Wiley & Sons.
2. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill Education.

Course Outcomes:

After completion of this course students will be able to-

1. Interpret the impact and challenges posed by IoT and the Internet technologies behind it.
2. Able to understand the new architectural models of IoT and the different communication protocols for connecting IoT nodes.
3. Compare and contrast the deployment of smart objects and the technologies to connect them to network.
4. To be capable of developing interoperability and compare them.
5. To be capable of implementing different Application protocols and security measures for IoT.

Name of the course		**Data Science**	
Course Code: PEC(IT)805E		**Semester: 8th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hours/week		Mid Semester Exams: 30 Marks	
Credit Points: 3		Assignment , Quiz, Attendance etc. : 20 Marks	
		End Semester Exam: 50 Marks	
Objective:			
1.	To provide with the basic understanding of data science and knowledge of proficient data science techniques.		
2.	To apply the concept of statistics in data science to analyze the data set.		
3.	To demonstrate the machine learning concepts that are vital for data science.		
4.	To evaluate the data visualization based on their design.		
Pre-Requisite:			
1.	IT Workshop(Python) PCL(CS/IT)305		
2.	Mathematics-II(BS(CS/IT)-205)		
Unit	Content	Hours	Marks
1	**Introduction to Data Science:** Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.	2	
2	**Introduction to R:** Data types and variables, Data Frames, Recasting and Joining Data Frames, Various mathematical operations, Control structures, Data visualization in R Graphics.	4	
3	**Linear Algebra for Data Science:** Linear equations, Distance, Hyperplanes, Halfsapces, Eigenvalues and Eigenvectors.	3	
4	**Statistical modelling:** Probability mass/density functions, Sample statistics, Hypotheses testing.	3	
5	**Optimization for Data Science:** Unconstrained multivariate optimization, Gradient Descent Learning, Constrained multivariate optimization.	4	
6	**Data Science problems and solution Framework:** Data analysis problem solving, Data collection and analysis techniques, Visualization techniques, Application development methods in data science.	5	
7	**Data visualisation:** Introduction, Types of data visualisation, Data for visualisation:	5	

	Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings. Technologies for visualisation, Bokeh (Python).		
8	**Predictive modelling and cross validation techniques:** Liner regression and Model assessment, Model building and assessment, Multiple Liner regression, Multiple liner modelling and selection,	5	
9	**Classification and clustering:** Logistic regression, performance measures. Logistic regression implementation in R, KNN clustering, KNN clustering implementation in R, K-means clustering, KNN clustering implementation in R, PCA in high dimensions, Spectral clustering and Cheeger's inequality	5	

Text Book(s):

1. Beginner's Guide for Data Analysis using R Programming, Jeeva Jose, Khanna Book Publishing.
2. Doing Data Science, Straight Talk from The Frontline, Cathy O'Neil and Rachel Schutt, O'Reilly.

Reference Book(s):

1. Data Science for Business: What You Need to Know about Data Mining and Data: analytic Thinking, Foster Provost and Tom Fawcett.

Course Outcomes:

After completion of this course students will be able to-

CO1: Illustrate the concepts of basic data science.

CO2: Solve data science problems using the skills of statistical and optimization methods.

CO3: Examine the data visualization based on their design.

CO4: Explain various machine learning techniques in data science.

Name of the course	**Image Processing**
Course Code: OEC(IT/CS)803A	**Semester: 8th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Two Mid term Exam: 30 Marks
Credit Points: 3	Assignment & Quiz: 10 Marks
	Term paper: 05 Marks
	Presentation on selected topics: 05 Marks
	End Semester Exam: 50 Marks

Objective:	
1.	To study the concept of image, definitions related to image
2.	To study image enhancement techniques in spatial and time domain

3.	To study noise in image and image restoration		
4.	To study segmentation and compression techniques of image		
5.	To study colour image process techniques		
Pre-Requisite			
1.	Knowledge of Fourier transform		
2.	Knowledge of digital data		
Unit	Content	Hrs	Marks
1	**Introduction:** Definition, Steps in Digital Image Processing, Components of an Image Processing System, Applications of Digital Image Processing, Neighbors of pixel, Adjacency, Connectivity, Region and Boundary, Distance Measures, Arithmetic/Logic Operations	6	15
2	**Digital image formation:** Light and the Electromagnetic Spectrum, Image Sensing and Acquisition. Image Sampling and Quantization, Image Model, Classification of Digital Images, Image File Formats	4	10
3	**Image transformation:** Need for Transform, Discrete Fourier Transform, Walsh Transform, Hadamard Transform, Discrete Cosine Transform, Karheunen-Loeve transform, Hough transform	4	14
4	**Image transformation in spatial domain:** Basic Gray Level Transformations, Histogram Processing, Convolution and Correlation, Image Smoothing through Spatial Filters, Image Sharpening through Spatial Filters	4	14
5	**Image transformation in time domain:** Image Smoothing through Frequency-Domain Filters, Image Sharpening through Frequency Domain Filters, Homomorphic Filtering	4	10
6	**Image restoration:** Types of Degradation, Types of Image Blur, Classification of Image Restoration Techniques, Image Restoration Model, Linear and Non-linear Image Restoration Techniques, Blind Deconvolution, Classification of Noise in Image, Image Denoising	4	13
7	**Image segmentation:** Classification of Image Segmentation Techniques, Edge based Segmentation, Classification of edges, Edge detection, Edge Linking, Region based approach to Segmentation, Clustering Techniques, Segmentation based on Thresholding, Watershed Transformation, Active Contour	4	12
8	**Image compression:** Spatial and Temporal Redundancy, Image Compression Models- Lossless and Lossy Compression.	4	10
9	**Colour image processing:** Colour Models, Colour Transformation, Image Segmentation based on Colour	2	5

Text Book(s):

[1] Digital Image Processing, Gonzalves and Woods, Pearson
[2] Digital Image Processing, Jahne, Springer India

Reference Book(s):

[1] Fundamentals of Digital Image Processing: A Practical Approach with Examples in Matlab, Solomon and Breckon, Wiley

Course Outcomess

After completion of this course students will be able to-

1. Asses different image enhancement techniques and application
2. Investigate different image segmentation algorithms
3. Compose different image restoration techniques for application in real time problems
4. Asses different colour models for enhancement, segmentation and restoration
5. Investigate different lossless and lossy compression
6. Real life design of problems and solution through image processing

Name of the course	**SOFTWARE PROJECT MANAGEMENT**
Course Code: OEC(IT/CS)803B	**Semester: 8th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Term I Exam: 15 Marks
Credit Points: 3	Mid Term II Exam: 15 Marks
	Assignments, Class performance & Attendance: 20 Marks
	End Semester Exam & Viva: 50 Marks

Objective:	
1.	To understand the Software Project Planning and Evaluation techniques.
2.	To plan and manage projects at each stage of the software development life cycle.
3.	To develop skills to manage the various phases involved in project management and people management.
4.	To deliver successful software projects that support organization's strategic goals.

Pre-Requisite			
	Software Engineering		
Unit	Content	Hrs	Marks
1	**SOFTWARE PROJECT** Concept of Project, Software project, Importance of Software Project Management, Activities, Methodologies, Categorization of Software Projects, Setting objectives, Project portfolio Management, Risk evaluation, Strategic program Management, Stepwise Project Planning**.**	6	
2	**PROJECT LIFE CYCLE AND EFFORT ESTIMATION** Software process and Process Models – Choice of Process models – Rapid Application development, Agile methods – Dynamic System	8	

	Development Method, Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points - COCOMO II - a Parametric Productivity Model.		
3	**ACTIVITY PLANNING AND RISK MANAGEMENT** Objectives of Activity planning, Project schedules, Activities, Sequencing and scheduling, Gantt chart, Network Planning models, Critical path method, PERT technique, Resource Allocation, Cost schedules. Industrial strength software: features & challenges. Risk identification, Assessment, Risk Planning, Risk Management: Proactive & Reactive risk management.	8	
4	**PROJECT MANAGEMENT AND CONTROL** Framework for Management and control, Collection of data, Visualizing progress, Cost monitoring, Earned Value Analysis, Project tracking, change control, Contract Management. Software Configuration Management- need, basic configuration, baseline of configuration. Concept of quality, quality attributes, iron triangle.	8	
5	**STAFFING IN SOFTWARE PROJECTS** Managing people, Organizational behavior, Best methods of staff selection, The Oldham – Hackman job characteristic model, Health and Safety, Ethical and Professional concerns – Working in teams, Decision making, Organizational structures, Dispersed and Virtual teams, Leadership, role of project manager.	6	

Text Book(s):

1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – TMH
2. Robert K. Wysocki —Effective Software Project Management‖ – Wiley
3. Software Engineering: A Practitioner's Approach- Roger Pressman--TMH

Reference Book(s):

1. Ingenieria del Software-- Ian Sommerville--Pearson
2. Walker Royce: —Software Project Management‖- Addison-Wesley
3. Gopalaswamy Ramesh, —Managing Global Software Projects- McGraw Hill
4. Software Engineering- Pankaj Jalote- Wiley India

Course Outcomes:

After completion of this course students will be able to-

1. Understand Project Management principles while developing software.
2. Identify the basic project management concepts, framework and the process models.
3. Review about software process models and software effort estimation techniques
4. Estimate the risks involved in various project activities.
5. Define the checkpoints, project reporting structure, project progress and tracking mechanisms using project management principles.
6. Determine staff selection process and the issues related to people management

Name of the course	**Social Network Analysis**
Course Code: OEC(IT/CS)803C	**Semester: 8th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Two Mid term Exam: 30 Marks
Credit Points: 3	Assignment & Quiz: 10 Marks
	Term paper: 05 Marks
	Presentation on selected topics: 05 Marks
	End Semester Exam: 50 Marks

Objective:

1.	To study the concept of online social network in graph theoretic concept
2.	To study centrality measures of online social network graph
3.	To study social network content and analyze the sentiment
4.	To study rumour detection in social media
5.	To study influence maximization and minimization in social media

Pre-Requisite

1.	Discrete mathematics BS(CS/IT)408
2.	DBMS PC(CS/IT)512

Unit	Content	Hrs	Marks
1	**Introduction:** A General Overview: online social network(OSN), online social network as graph, topology, Erdos Reyni concept of graph, concept of six degree separation, small world network, large scale network, propagation approaches through social network graph	2	6
2	**Centrality measures:** Graph centrality concept, Node degree centrality, Betweenness centrality, closeness centrality, page rank centrality, Eigen vector centrality, K-core	6	15
3	**Sentiment analysis:** Sentiment: positive, negative and neutral. NLP for analysis of sentiment, machine learning approaches for analysis of sentiment in OSN	5	15
4	**Rumour detection:** Detection of rumour in social network, content based rumour detection, generating dictionary for identifying misinformation, machine learning approaches to differentiate rumour content, interaction based rumour detection, identifying the profile generating rumour	5	15
5	**Influence maximization:** Introductory concepts. Different approaches of influence maximization. Recent trends in influence maximization, applications.	6	15
6	**Influence minimization:** Introductory concepts. Different approaches of influence minimization. Application of influence minimization for rumour content in OSN	4	12

7	**Clustering and community detection:** Community detection in online social network, clustering, clustering coefficient, modularity, transitivity, average path length	4	10
8	**Application of SNA:** Real world social network issues and solution	4	12

Text Book(s):

1.

Reference Book(s):

1.

Course Outcomes:

After completion of this course students will be able to-

1. Assess proficiency and understanding of social networks for business and professional use
2. Investigate different use of social network analysis and social network developer tools
3. Assess different centrality measures and community detection mechanisms for different applications
4. Compose different influence maximization/minimization problems
5. Investigate different content of social network and validate the sentiments and purposes.
6. Design real life solution for online social network issues.

Name of the course		**QUANTUM COMPUTING**	
Course Code: OEC(IT/CS))803D		**Semester: 8th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs./week		Mid Term I: 15 Marks	
Credit Points: 3		Mid Term II: 15 Marks	
		Assignment, Test based on assignments, Surprise tests, Quizzes, Presentations, Attendance etc. : 20 Marks	
		End Semester Exam: 50 Marks	
Objectives :			
1.	To develop mathematical foundation for application in Quantum Computing.		
2.	To introduce the fundamentals of quantum computing and understand the basic postulates of quantum mechanics.		
3.	To apply quantum algorithms for solving various problems**.**		
Pre-Requisites :			
1.	Mathematics I [BS(CS/IT)101], Physics [BS(CS/IT)]102		
2.	Design and Analysis of Algorithms [PC(CS/IT)406]		
Unit	Content	Hrs	Marks

1	**Mathematical Preliminaries:** Representation of states in linear vector space, Basis and Dimensions, Inner Product, Orthonormality, Bra-Ket Formalism, Hilbert Space, Hermitian, Unitary, Normal and Projection Operators, Tensor Product, Density Operator.	8	15
2	**Introduction to Quantum Mechanics:** Classical Deterministic Systems, Probabilistic Nature of Quantum Systems, Basics of Quantum Theory, Schrodinger's Equation and Born Rule, Wave - Particle Duality, Postulates of Quantum Mechanics, Dirac Formalism, Stren-Grelach Experiment and Measurement, Electron Spin, Superposition of States, Quantum Entanglement.	6	15
3	**Quantum Circuits:** Bits and Qubits, Bloch sphere representation of a qubit, multiple qubits. Classical gates versus quantum gates, single qubit gates, multiple qubit gates, design of quantum circuits.	8	20
4	**Quantum Information and Cryptography:** Comparison between classical and quantum information theory. Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem.	8	25
5	**Quantum Algorithms:** Introduction to quantum algorithm, quantum parallelism, Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor factorization algorithm, Grover Search algorithm, Simon's algorithm, Quantum Fourier Transform.	8	25

Text Book(s):

1. Quantum Computation and Quantum Information, Michael A. Nielsen and Isaac L. Chuang, Cambridge University Press 2010.
2. Quantum computing explained, David McMahon, Wiley-interscience, John Wiley & Sons, Inc. Publication 2008.

Reference Book(s):

1. Quantum computing for computer scientists, Noson S. Yanofsky, Mirco A. Mannucci, Cambridge University Press 2008
2. Introduction to Quantum Mechanics, 2nd Edition, David J. Griffiths, Prentice Hall New Jersey 1995
3. Presskil Lecture notes http://www.theory.caltech.edu/~preskill/ph229/.Engineering Circuit Analysis, W.H. Hyat, J.E. Kemmerly & S.M. Durbin, The Mc Graw Hill
4. Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, Benenti G., Casati G. and Strini G, World Scientific.

Course Outcomes:

After completion of this course students will be able to-

CO1: Understand Hilbert Space and Operators.

CO2: Explain basic concepts of quantum mechanics as applied in Quantum computing.

CO3: Develop quantum logic gate circuits.

CO4: Differentiate the classical and quantum information processing concepts.

CO5: Implementation of simple quantum algorithms using quantum parallelism.

Name of the course	**Bioinformatics**
Course Code: OEC(IT/CS)803E	**Semester: 8th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Mid Term I: 15 Marks
Credit Points: 3	Mid Term II: 15 Marks
	Assignments, Test based on assignments, Surprise tests, Quizzes, Presentations, Attendance etc. : 20 Marks
	End Semester Exam: 50 Marks

Objective:	
1.	To provide an introduction to what bioinformatics is and why it is important.
2.	To describe how bioinformatics data is stored and organized.
3.	To classify different types of Biological Databases.
4.	To learn how to extract sequence from a database.
5.	To describe the basics of theoretical protein structure prediction.
Pre-Requisite	
1.	Programing for Problem Solving [ES(CS/IT)204]
2.	High School Biology

Unit	Content	Hrs	Marks
1	**Definition and Scope:** Definition, Scope and importance of bioinformatics, Role of internet in bioinformatics	5	
2	**Biological Data and Management:** Characteristics of biological data-types and features, Data management-organization of data, Analysis and Introduction of Biological Data Management System	7	
3	**Biological Database:** Relevance and scope of biological databases, Classification of Biological database, DNA and proteins databases-NCBI, EBI, Uniprot, Omics in biology - genomics, transcriptomics, proteomics and metabolomics.	8	
4	**Sequence Analysis:** Outline of sequence, Structure and functions of DNA and Proteins, Introduction and Application to Sequence analysis, Sequence alignment- Introduction, Types- Local, Global, Pairwise Alignment, Multiple Alignment	9	
5	**Structural Principles:** Overview of macromolecular structures - DNA and proteins, Protein structure database –CATH, SCOP, PDB, Basics of theoretical protein structure prediction	7	

Text Book(s):

1. Dr. Zhumar Ghosh, Bibekanand Mallick, Bioinformatics, Oxford University Press India

2. Orpita Bosu, Simminder Kaur Thukral, Bioinformatics - Databases, Tools, and Algorithms, Oxford University Press India
3. S.C. Rastogi, Namita Mendiratta, Parag Rastogi, Bioinformatics - Concepts, Skills & Applications, CBS Publishers & Distributors
4. Prakash S. Lohar, Bioinformatics, Mjp Publishers

Reference Book(s):

1. Jin Xiong, Essential Bioinformatics, Cambridge
2. D. W. Mount, Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press

Course Outcomes:

After completion of this course students will be able to-

1. Describe the scope and importance of Bioinformatics and role of internet in Bioinformatics.
2. Characterize and manage the different types of Biological data.
3. Locate and extract data from key bioinformatics databases and resources.
4. Apply the basics of sequence alignment and analysis.
5. Describe the biological macromolecular structures and structure prediction methods.

MOOCs courses for 8TH Semester, 2021-22

Bucket for Professional Elective

Code: PEC(IT)805M - 1/2/3/4

SL. NO.	Code	Name	Instructor	Organization	Duration
1	**noc22-cs11	Data Mining	Prof. Pabitra Mitra	IITKGP	8 weeks
2	noc22-cs53	Introduction To Internet Of Things	Prof. Sudip Misra	IITKGP	12 weeks
3	**noc22-cs10	Advanced Computer Architecture	Prof. John Jose	IITG	8 Weeks
4	**noc22-cs24	Machine Learning, ML	Prof. Carl Gustaf Jansson Prof. Henrik Boström Prof. Fredrik Kilander	IITM	8 Weeks

Bucket for Open Elective

Code: OEC(IT/CS)803M - 1/2/3

SL. NO.	Code	Name	Instructor	Organization	Duration
1	noc22-cs30	Social Networks	Prof. Sudarshan Iyengar Prof. Yayati Gupta	IIT Ropar	12 weeks
2	noc22-cs54	Introduction To Soft Computing	Prof. Debasis Samanta	IITKGP	8 Weeks
3	**noc22-cs17	Advanced Graph Theory	Prof. Rajiv Misra	IIT Patna	8 Weeks

#: Students, who are doing Internship (offline) and not in a position to attend regular classes offered by the department have to choose one MOOCs course from each bucket (provided not done earlier). The course must be endorsed/ permitted by the department. The submission of proper documents of successful completion of those courses is a must criterion to be eligible for completion of the semester. Documents of successful completion of the courses must be submitted to the department as well as to the controller section, failing of which will be treated as supplementary for those courses in the 8TH semester.