Kavayitri Bahinabai Chaudhari
NORTH MAHARASHTRA UNIVERSITY,
JALGAON (M.S.)

Final Year Engineering

(Computer Engineering / Information Technology)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
3rd Cycle

SYLLABUS STRUCTURE

Semester – VII & VIII

W.E.F. 2021 – 22

Syllabus Structure for Final Year Engineering (Semester – VII) (Computer / Information Technology) (w.e.f. 2021 – 22)
(As per AICTE Guidelines)

Name of the Course	Group	Teaching Scheme				Evaluation Scheme					Credits
						Theory		Practical		Total	
		Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE		
Complier Design	D	3	-	-	3	40	60	-	-	100	3
Professional Elective Course – III	E	3	-	-	3	40	60	-	-	100	3
Professional Elective Course – IV	E	3	-	-	3	40	60	-	-	100	3
Open Elective Course – III	F	3	-	-	3	40	60	-	-	100	3
Complier Design Lab	D	-	-	2	2	-	-	25	25 (PR)	50	1
Advanced Technology Lab - I	D	1	-	2	3	-	-	25	25 (PR)	50	2
Project (Stage – I)	G	-	-	12	12	-	-	50	50 (OR)	100	6
Essence of Indian Traditional Knowledge	H	-	-	-	-	-	-	-	-	-	-
		13		**16**	**29**	**160**	**240**	**100**	**100**	**600**	**21**

ISE: Internal Sessional Examination ESE: End Semester Examination ICA: Internal Continuous Assessment

Professional Elective Course – III		Professional Elective Course – IV		Open Elective Course – III	
1	Machine Learning	1	Data Mining	1	Human Resource Management
2	Internet of Things	2	Distributed Systems	2	Industrial Engineering
3	Ad-Hoc and Sensor Networks	3	Cloud Computing	3	Quantitative Reasoning and Problem Solving
4	Virtual Reality	4	Human Computer Interaction	4	Entrepreneurship Development

Syllabus Structure for Final Year Engineering (Semester – VIII) (Computer / Information Technology) (w.e.f. 2021 – 22)
(As per AICTE Guidelines)

Name of the Course	Group	Teaching Scheme				Evaluation Scheme					Credits
						Theory		Practical		Total	
		Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE		
Cyber Security	D	3	-	-	3	40	60	-	-	100	3
Professional Elective Course – V	E	3	-	-	3	40	60	-	-	100	3
Professional Elective Course – VI	E	3	-	-	3	40	60	-	-	100	3
Open Elective Course – IV	F	3	-	-	3	40	60	-	-	100	3
Cyber Security Lab	D	-	-	2	2	-	-	25	25 (OR)	50	1
Advanced Technology Lab - II	D	2	-	2	4	-	-	25	25 (PR)	50	3
Project	G		-	6	6	-	-	50	50 (OR)	100	3
		14	**0**	**10**	**24**	**160**	**240**	**100**	**100**	**600**	**19**

ISE: Internal Sessional Examination **ESE: End Semester Examination** **ICA: Internal Continuous Assessment**

Professional Elective Course – V		Professional Elective Course – VI		Open Elective Course – IV	
1	Soft Computing	1	Data Analytics	1	Ethical Practices in Business
2	Advanced Operating Systems	2	Blockchain	2	Total Quality Management
3	Mobile Computing	3	Quantum Computing	3	Logical Reasoning and Problem Solving
4	Business Analytics and Intelligence	4	Information Retrieval	4	Robotics

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COURSE OUTLINE

Semester - VII

W.E.F. 2021 – 22

Compiler Design					
COURSE OUTLINE					
Course Title:	**Compiler Design**	**Short Title:**	**CD**	**Course Code:**	
Course description:					
This course is aimed at introducing the fundamentals of Compiler Design to undergraduate students.					
Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	3	**14**	**42**	**3**	
Prerequisite course(s):					
Formal Language & Automata Theory					
Course objectives:					
1. To learn phases of Compiler. 2. To understand parsing techniques. 3. To learn Syntax-Directed Translation and Intermediate-Code generation. 4. To understand Run-Time Environments. 5. To learn Code Generator.					
Course outcomes:					
After successful completion of this course the student will be able to:					
1. Design Lexical Analyzer. 2. Design Syntax Analyzer. 3. Generate Intermediate Code. 4. Illustrate different storage management schemes. 5. Design Code Generator					
COURSE CONTENT					
Compiler Design			**Semester:**	**VII**	
Teaching Scheme:			**Examination scheme:**		
Lectures:	**3 hours/week**		**End Semester Exam (ESE):**		**60 marks**
			Duration of ESE:		**03 hours**
			Internal Sessional Exam (ISE):		**40 marks**
Unit–I:	**No. of Lectures: 09 Hours**		**Marks: 12**		
Introduction: Language Processors, The Structure of a Compiler, Applications of Compiler Technology **Lexical Analysis:** The Role of the Lexical Analyzer, Input Buffering, The Lexical -Analyzer Generator Lex **Syntax Analysis:** Introduction, Top-Down Parsing: Recursive-Descent Parsing, FIRST and FOLLOW, LL(l) Grammars, Nonrecursive Predictive Parsing, Error Recovery in Predictive Parsing					
Unit–II:	**No. of Lectures: 08 Hours**		**Marks: 12**		

Bottom-Up Parsing: Reductions, Handle Pruning, Shift-Reduce Parsing, Conflicts During Shift-Reduce Parsing

Introduction to LR Parsing: Simple LR, Why LR Parsers?, Items and the LR(O) Automaton, The LR-Parsing Algorithm, Constructing SLR-Parsing Tables, Viable Prefixes

More Powerful LR Parsers: Canonical LR(l) Items, Constructing LR(l) Sets of Items, Canonical LR(l) Parsing Tables, Constructing LALR Parsing Tables, Efficient Construction of LALR Parsing Tables, Compaction of LR Parsing Tables,

Parser Generators: The Parser Generator Yacc, Using Yacc with Ambiguous Grammars, Creating Yacc Lexical Analyzers with Lex, Error Recovery in Yacc

Unit–III:	No. of Lectures: 09 Hours	Marks: 12

Syntax-Directed Translation: Syntax-Directed Definitions: Inherited and Synthesized Attributes, Evaluating an SDD at the Nodes of a Parse Tree, Evaluation Orders for SDD's: Dependency Graphs, Ordering the Evaluation of Attributes, S-Attributed Definitions, L-Attributed Definitions, Semantic Rules with Controlled Side Effects, Applications of Syntax-Directed Translation: Construction of Syntax Trees, The Structure of a Type, Syntax-Directed Translation Schemes: Postfix Translation Schemes, Parser-Stack Implementation of Postfix SDT's, SDT's With Actions Inside Productions, Eliminating Left Recursion From SDT's, SDT's for L-Attributed Definitions

Intermediate-Code Generation: Variants of Syntax Trees: Directed Acyclic Graphs for Expressions, The Value-Number Method for Constructing DAG's, Three-Address Code: Addresses and Instructions, Quadruples, Triples, Static Single-Assignment Form

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Run-Time Environments: Storage Organization: Static Versus Dynamic Storage Allocation, Stack Allocation of Space: Activation Trees, Activation Records, Calling Sequences, Variable-Length Data on the Stack

Heap Management: The Memory Manager, he Memory Hierarchy of a Computer, Locality in Programs, Reducing Fragmentation, Manual Deallocation Requests

Introduction to Garbage Collection: Design Goals for Garbage Collectors, Reachability, Reference Counting Garbage Collectors

Introduction to Trace-Based Collection: A Basic Mark-and-Sweep Collector, Basic Abstraction, Optimizing Mark-and-Sweep, Mark-and-Compact Garbage Collectors, Copying collectors, Comparing Costs

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Code Generation: Issues in the Design of a Code Generator : Input to the Code Generator, Instruction Selection, Register Allocation, Evaluation Order

The Target Language: A Simple Target Machine Model, Program and Instruction Costs

Basic Blocks and Flow Graphs: Basic Blocks, Next-Use Information, Flow Graphs, Representation of Flow Graphs, Loops

Optimization of Basic Blocks: The DAG Representation of Basic Blocks, Finding Local Common Subexpressions, Dead Code Elimination, The Use of Algebraic Identities, Representation of Array References, Pointer Assignments and Procedure Calls , Reassembling Basic Blocks From DAG's

Simple Code Generator: Register and Address Descriptors , The Code-Generation Algorithm, Design of the Function getReg

Peephole Optimization: Eliminating Redundant Loads and Stores, Eliminating Unreachable Code, Flow-of-Control Optimizations, Algebraic Simplification and Reduction in Strength, Use of Machine Idioms

Register Allocation and Assignment: Global Register Allocation, Usage Counts, Register Assignment for Outer Loops, Register Allocation by Graph Coloring

Text Books:

1. Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D Ullman- “Compilers- Principles, Techniques and Tools”, 2nd edition, Pearson, 2014.

Reference Books:

1. K. Cooper, L, Torczon, "Engineering a Compiler", Morgan Kaufinann Publishers
2. K. Louden, "Compiler Construction: Principles and Practice", Cengage Learning
3. J. R. Levine, T. Mason, D. Brown, "Lex &Yacc", O'Reilly, 2000
4. S. Chattopadhyay, "Compiler Design", Prentice-Hall of India, 2005

Machine Learning (Professional Elective Course – III)					
COURSE OUTLINE					
Course Title:	**Machine Learning**	**Short Title:**	**ML**	**Course Code:**	
Course description:					
This course provides a broad introduction to machine learning, Topics include Supervised learning, Unsupervised learning, Best practices in machine learning. The course will also draw from numerous case studies and applications, so that you'll also learn how to apply learning algorithms to building smart robots (perception, control), text understanding computer vision, medical informatics, audio, database mining, and other areas.					
Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	3	**14**	**42**	**3**	
Prerequisite course(s):					
Artificial Intelligence, Neural Network					
Course objectives:					
1. To introduce students to the basic concepts and techniques of Machine Learning. 2. To Characterize machine learning algorithms as supervised, semi-supervised, and unsupervised. 3. To gain skills for solving practical problems by machine learning.					
Course outcomes:					
After successful completion of this course the student will be able to:					
1. Recognize the characteristics of machine learning that make it useful to real-world problems. 2. Able to use regularized regression and Classification algorithms. 3. Evalute machine learning algorithms and model selection. 4. Understand scalable machine learning and machine learning for IoT. 5. Understand Deep leaning and Expert system.					
COURSE CONTENT					
Machine Learning			**Semester:**	**VII**	
Teaching Scheme:			**Examination Scheme:**		
Lectures:	**3 hours/week**		**End Semester Exam (ESE):**	**60 marks**	
			Duration of ESE:	**03 hours**	
			Internal Sessional Exam (ISE):	**40 marks**	
Unit–I:	**No. of Lectures: 09 Hours**		**Marks: 12**		
Introduction to Machine Learning: Types of Machine Learning Algorithms, Supervised Learning, Unsupervised learning, Reinforcement Learning, Classification of Machine Learning Concept, Distance Based Machine learning Methods, K-Nearest Neighbor (kNN). Introduction to Clustering Techniques, Possible Applications, Requirements of clustering algorithm, Types of Clustering Methods, Clustering Strategies.					

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**
Classification / Regression: Classifications, decision tree learning, naive bayes, linear regression, logistic regression, Linear regression models, support vector machine, beyond binary classifications: multiclass or multinomial classification.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Evaluating machine learning algorithms and model selection: Machine Learning Algorithms, Designing Machine Learning Algorithms, Classification Metrics Regression Metrics, Statistical Learning Theory, Ensemble Methods, What is Random Forest **Sparse modeling and estimation**: Time series, Deep (Structured) Learning, Neural Network, Applications of Deep Learning Methods, Feature Representation Learning.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Scalable machine learning: Semi-Supervised Machine Learning, Semi-Supervised Learning, When Can Semi-Supervised Learning Work?, Active (Machine) Learning, Graphical Model, Inference on Graphical Models, Probabilistic Graphical Models (PGM). **Machine learning & IoT :** Internet of Things, Emergence of Internet of Things, The Architecture of IoT, Machine Learning Algorithm for IoT, Internet of Things Communication Protocols, The IoT Architectural Reference Model, Taxonomy of Machine Learning Algorithms		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Deep Learning : Neurons, Linear Perceptrons as Neurons, Neural Nets Architecture/ Design, Working of Neural Nets, Layers of Neural Networks and Deep learning, Activation Functions, Feed Forward Neural Networks, Limitations of Neurons Deep Belief Networks (DBNs) Large Scale DBNs, Large Scale Convolutional Neural Networks, Deep Learning for Big Data, Deep Learning from High Volumes of Data, Deep Learning from High Variety of Data ,Deep Learning for High Velocity of Data ,Local Minima in Deep Networks, Rearranging Neurons in a layer of a Neural Network, Spurious Local Minima in Deep Networks. **Expert System**: Characteristics, Components, Development, Knowledge Engineering, Application.		
Text Books:		
1. V.K. Jain, Machine Learning, Khanna Publishing House. 2. Rajiv Chopra, Deep Learning. 3. Vinod Chandra S.S., Artificial Intelligence & Machine Learning, PHI.		
Reference Books:		
1. Rajiv Chopra, Machine Learning, Khanna Book Publishing, New Delhi. 2. Mitchell Tom, Machine Learning. McGraw Hill, 1997. 3. Ethem Alpaydin, Introduction to Machine Learning, PHI.		

Internet of Things (Professional Elective Course – V)					
COURSE OUTLINE					
Course Title:	**Internet of Things**	**Short Title:**	**IoT**	**Course Code:**	
Course description:					
This course develops a foundation of concepts and solutions that supports the project planning & management concepts. Describe how to managing development of project by applying project management concepts. Project risk management provides students with an organized approach for managing the uncertainties that can lead to undesirable project outcomes. Course topics include: Project procurement management and post project analysis.					
Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	3	**14**	**42**	**3**	
Prerequisite course(s):					
Course objectives:					
The objective of this course is to impart necessary and practical knowledge of components of Internet of Things and develop skills required to build real-life IoT based projects.					
Course outcomes:					
After successful completion of this course the student will be able to:					
1. Understand the design principles for connected devices 2. Understand the design principles of Internet connectivity 3. Analyze the concepts of knowledge acquiring, managing and storing 4. Understand the wide variety of sensors 5. Design the software for IoT applications					
COURSE CONTENT					
Internet of Things			**Semester:**	**VIII**	
Teaching Scheme:			**Examination Scheme:**		
Lectures:	**3 hours/week**		**End Semester Exam (ESE):**	**60 marks**	
			Duration of ESE:	**03 hours**	
			Internal Sessional Exam (ISE):	**40 marks**	
Unit–I:	**No. of Lectures: 09 Hours**		**Marks: 12**		
Internet of Things: An Overview: Internet of Things, IoT Conceptual Framework, IoT Architectural View, Technology Behind IoT, Sources of IoT, M2M Communication, Examples of IoT **Design Principles for Connected Devices**: IoT/M2M Systems Layers and Designs Standardization, Communication Technologies, Data Enrichment, Data Consolidation and Device Management at Gateway, Ease of Designing and Affordability					
Unit–II:	**No. of Lectures: 08 Hours**		**Marks: 12**		

Design Principles for Web Connectivity: Web Communication Protocols for Connected Devices, Message Communication Protocols for Connected Devices, Web Connectivity for Connected-Device a Network using Gateway, SOAP, REST, HTTP RESTful and WebSockets
Internet Connectivity Principles: Internet Connectivity, Internet-Based Communication, IP Addressing in the IoT, Media Access Control, Application Layer Protocols: HTTP, HTTPS, FTP, Telnet and Others

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Data Acquiring, Organizing, Processing and Analytics: Data Acquiring and Storage, Organizing the Data, Transactions, Business Processes, Integration and Enterprise System, Analytics, Knowledge Acquiring, Managing and Storing Processes,
Data Collection, Storage and Computing Using Cloud Platform: Cloud Computing Paradigm for Data Collection, Storage and Computing, Everything as a Service and Cloud service Models, IoT Cloud-Based Services using the Xively, Nimbits and Other Platforms

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Sensors, Participatory Sensing, RCIDs, and Wireless Sensor networks: Sensor Technology, Participatory Sensing, Industrial IoT and Automotive IoT, Actuator, Sensor Data Communication Protocols, Radio Frequency Identification Technology, Wireless Sensor Networks Technology
Prototyping the Embedded Devices for IoT and M2M: Embedded Computing Basics, Embedded Platforms for Prototyping, Things Always Connected to the Internet/Cloud.

Unit–V:	No. of Lectures: 09 Hours	Marks: 12

Prototyping and Designing the software for IoT Applications: Prototyping Embedded Device Software, Devices, Gateways, Internet and Web/Cloud Services Software-Development, Prototyping Online Component APIs and Web APIs
IoT Privacy, Security and Vulnerabilities Solutions: Vulnerabilities, Security Requirements and Threat Analysis, Use Cases and Misuse Cases, IoT Security Tomography and Layered Attacker Model, Identity Management and Establishment, Access Control and Secure Message Communication, Security Models, Profiles and Protocols for IoT

Text Books:

1. Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill

Reference Books:

1. Jeeva Jose, “Internet of Things”, Khanna Publishing House, Delhi

Ad-Hoc and Sensor Networks (Professional Elective Course – III)

COURSE OUTLINE

Course Title:	**Ad-Hoc and Sensor Networks**	**Short Title:**	**ASN**	**Course Code:**	

Course description:

The course introduces advanced concepts in wireless networking covering all important design issues, routing, transport layer, security and energy management in Ad-Hoc wireless networks. Some recent related important topics are also introduced such as wireless sensor networks, hybrid wireless networks and pricing in multi-hop wireless networks.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**14**	**42**	**3**

Prerequisite course(s):

Knowledge of Data Communication and Computer Networking

Course objectives:

The course deals with knowledge of different methods in ad-hoc and sensor networks. The objective of the course is to introduce ad-hoc and sensor networks and their need in future advanced wireless networks.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain the basic concepts and applications of ad-hoc and sensor networks.
2. Analyze and discuss routing protocols for wireless ad-hoc networks.
3. Describe routing protocols for hybrid wireless networks.
4. Illustrate transport layer solutions for ad-hoc networks.
5. Explain the concepts of sensor network architecture.

COURSE CONTENT

Ad-Hoc and Sensor Networks		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Ad Hoc Wireless Networks:

Introduction: Cellular and Ad Hoc Wireless Networks, Applications of Ad Hoc Wireless Networks, Issues in Ad Hoc Wireless Networks: Medium Access Scheme, Routing, Multicasting, Transport Layer Protocols, Pricing Scheme, Quality of Service Provisioning, Self-Organization, Security, Addressing and Service Discovery, Energy Management, Scalability, Deployment Considerations, Ad Hoc Wireless Internet, Energy Management in Ad Hoc Wireless Networks: Introduction, Need for Energy Management in Ad Hoc Wireless Networks, Classification of Energy Management Schemes

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**
Routing Protocols for Ad Hoc Wireless Networks: Introduction, Issues in designing a routing protocol : Mobility, Bandwidth Constraint, Error-Prone Shared Broadcast Radio Channel, Hidden and Exposed Terminal Problems, Resource Constraints, Characteristics of an Ideal Routing Protocol, Classification of Routing Protocols, Table-Driven Routing Protocols, On Demand Routing Protocols, Hybrid Routing Protocols: ZRP, Power-Aware Routing Protocols		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Hybrid Wireless Networks: Introduction, Routing in Hybrid Wireless Networks: Base-Assisted, Base-Driven Multi-hop Bridging, SMCN, DWiLL Routing Protocols, Pricing in Multi-Hop Wireless Networks: Issues in Pricing, Pricing in Military Ad Hoc Wireless Networks, Pricing in Multi-Hop Wireless WANs, Pricing in Ad Hoc Wireless Networks, Open Issues in Pricing, Power Control Schemes in Hybrid Wireless Networks, Issues in Using Variable Power in IEEE 802.11, Power Optimization Scheme		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Transport Layer and Security Protocols for Ad Hoc Wireless Networks: Introduction, Issues in designing a Transport Layer Protocol, Design Goals, Classification of Transport Layer Solutions, TCP over Ad Hoc Wireless Networks, Security, Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Key Management, Secure Routing		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Wireless Sensor Networks: Introduction, Sensor Network Architecture, Data Dissemination, Data Gathering, Location Discovery, Quality of Sensor Network, Evolving Standards, Other Issues		
Text Books:		
1. Ad Hoc Wireless Networks: Architectures and Protocols by C. Siva Ram Murthy and B.S. Manoj, Pearson Education, 2nd Edition (LPE), 2004.		
Reference Books:		
1. Guide to Ad Hoc Networks by Editors Sudip Misra, Issac Woungang and Subhash Chandra Misra, Springer, 2009.		

Virtual Reality (Professional Elective Course – III)					
COURSE OUTLINE					
Course Title:	**Virtual Reality**	**Short Title:**	**VR**	**Course Code:**	
Course description:					
Virtual Reality (VR) is the use of computer technology to create a simulated environment. Unlike traditional user interfaces, VR places the user inside an experience. Instead of viewing a screen in front of them, users are immersed and able to interact with 3D worlds.					
Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	3	**14**	**42**	**3**	
Prerequisite course(s):					
Fundamentals knowledge of Computer Graphics					
Course objectives:					
1. To understand Geometric modeling and Virtual environment. 2. To understand Geometric Transformations. 3. To learn Animation for the Virtual Environment. 4. To Know about Virtual Hardware and Software **5.** To learn Virtual Reality applications.					
Course outcomes:					
After successful completion of this course the student will be able to:					
1. Describe Geometric modeling and Virtual environment. 2. Use Geometric Transformations for creation of various geometric objects 3. Apply knowledge of Animation for the Virtual Environment. 4. Explain Virtual Hardware and Software 5. Analyze Virtual Reality applications.					
COURSE CONTENT					
Virtual Reality			**Semester:**	**VII**	
Teaching Scheme:			**Examination Scheme:**		
Lectures:	**3 hours/week**		**End Semester Exam (ESE):**	**60 marks**	
			Duration of ESE:	**03 hours**	
			Internal Sessional Exam (ISE):	**40 marks**	
Unit–I:	**No. of Lectures: 09 Hours**		**Marks: 12**		
Virtual Reality and Virtual Environment: Introduction, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark .3D Computer Graphics: Introduction, The Virtual world space, positioning the virtual observer ,the perspective projection, human vision, stereo perspective projection, 3D clipping, Color theory.					
Unit–II:	**No. of Lectures: 09 Hours**		**Marks: 12**		
Simple 3D modeling, Illumination models, Reflection models, Shading algorithms, radiosity,					

Hidden Surface Removal, Realism-Stereographic image. Geometric Modeling: Introduction, From 2D to 3D, 3D space curves, 3D boundary representation.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Geometrical Transformations: Introduction, Frames of reference, Modeling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection. Generic VR system: Introduction, Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Animating the Virtual Environment: Introduction, The dynamics of numbers, shape & object inbetweening, free from deformation, particle system. Physical Simulation: Introduction, Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Human factors: Introduction, the eye, the ear, the somatic senses. VR Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems.VR Software: Introduction, Modeling virtual world, Physical simulation, VR toolkits, Introduction to VRML.VR Applications: Introduction, Engineering, Entertainment, Science, Training. The Future: Virtual environment, modes of interaction

Text Books:

1. John Vince, "Virtual Reality Systems ", Pearson Education Asia, 2007.

Reference Books:

1. Adams, "Visualizations of Virtual Reality", Tata McGraw Hill, 2000.
2. Grigore C. Burdea, Philippe Coiffet, "Virtual Reality Technology", Wiley Inter Science, 2nd Edition, 2006.
3. William R. Sherman, Alan B. Craig, "Understanding Virtual Reality: Interface, Application and Design", Morgan Kaufmann, 2008.

Data Mining (Professional Elective Course – IV)					
COURSE OUTLINE					
Course Title:	**Data Mining**	**Short Title:**	**DM**	**Course Code:**	

Course description:

This course is designed to expand students' knowledge and skills gained in database management courses and look in depth at data warehousing and data mining methods. The course examines the database architecture and technologies required for solving complex problems of data and information management, information retrieval, and knowledge discovery facing modern organizations.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	14	42	3

Prerequisite course(s):

Database Management System

Course objectives:

1. To introduce students to the basic concepts and techniques of Data Mining.
2. To develop skills of using recent data mining software for solving practical problems.
3. To gain experience of doing independent study and research.
4. To study the methodology of engineering legacy databases for data warehousing and data mining to derive business rules for decision support systems.
5. Develop and apply critical thinking, problem-solving, and decision-making skills.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand Data Warehouse fundamentals, Data Mining Principles.
2. Describe different steps in data preprocessing used for data mining.
3. Characterize the kinds of patterns that can be discovered by mining.
4. Apply different data-mining technique for classification of data.
5. Categorize and carefully differentiate between cluster and outlier analysis.

COURSE CONTENT

Data Mining		Semester:	VII
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	No. of Lectures: 09 Hours	Marks: 12

Introduction: What Is a Data Warehouse? Differences between Operational Database Systems and Data Warehouses, But, Why Have a Separate Data Warehouse?, What Is Data Mining?, What Kinds of Patterns Can Be Mined?: Class/Concept Description: Characterization and Discrimination, Mining Frequent Patterns, Associations, and Correlations, Classification and Regression for Predictive Analysis, Outlier Analysis, Major Issues in Data Mining: Mining

Methodology, User Interaction, Efficiency and Scalability, Diversity of Database Types, Data Mining and Society.		
Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**
Data Preprocessing : Data Preprocessing: An Overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization .		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Mining Frequent Patterns : Basic Concepts, Apriori Algorithm: Finding Frequent Item sets by Confined Candidate Generation, Generating Association Rules from Frequent Item sets, Mining Multilevel Associations, Constraint-Based Frequent Pattern Mining.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Classification: Basic Concepts, Decision Tree Induction, Bayes Classification Methods, Rule-Based Classification, Classification by Back-propagation, Support Vector Machines, Lazy Learners, Other Classification Methods.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Cluster Analysis : Basic Concepts and Methods, Partitioning Methods, Hierarchical Methods : Agglomerative versus Divisive Hierarchical Clustering, Density-Based Methods: DBSCAN, Grid-Based Methods : STING, Outliers and Outlier Analysis		
Text Books:		
1. Jiawei Han and Micheline Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann, 3rd edition (July 2011). 2. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Introduction to Data Mining. Pearson (2005).		
Reference Books:		
1. T. Hastie, R. Tibshirani and J. H. Friedman, The Elements of Statistical Learning, Data Mining, Inference, and Prediction. Springer, 2nd Edition, 2009. 2. C. M. Bishop, Pattern Recognition and Machine Learning. Springer, 1st edition, 2006		

Distributed System (Professional Elective Course – IV)					
COURSE OUTLINE					
Course Title:	**Distributed System**	**Short Title:**	**DS**	**Course Code:**	
Course description:					
The aim of this course is to introduce the students, a clear description of the fundamental concept and design principles that underlie distributed OS. It does not concentrate on any particular distributed OS or hardware. Instead the course discusses various fundamental concepts which are applicable to variety of distributed OS.					
Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	3	**14**	**42**	**3**	
Prerequisite course(s):					
Operating System, Computer Network					
Course objectives:					
1. To acquire the basic knowledge of Distributed System. 2. To gain knowledge to understands Remote Procedure Calls and the concept of shared memory. 3. To know synchronization and process Management in Distributed Operating System. 4. To understand distributed file system along with it's model and Naming. 5. To acquire knowledge of resource Management in Distributed Operating System.					
Course outcomes:					
After successful completion of this course the student will be able to:					
1. Describe fundamentals of distributed computing system along with message passing. 2. Explain Remote Procedure Calls and understands Distributed shared memory. 3. Describe synchronization, Election Algorithm and Process Management, with role of threads. 4. Discuss distributed file system along with it's model and Naming. 5. Justify resource management and scheduling algorithm.					
COURSE CONTENT					
Distributed System		**Semester:**	**VII**		
Teaching Scheme:		**Examination scheme:**			
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**		
		Duration of ESE:	**03 hours**		
		Internal Sessional Exam (ISE):	**40 marks**		
Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**			
Fundamentals: What is a distributed computing system, Evolution of distributed computing systems, Distributed computing system models, Why are distributed computing system gaining popularity, What is distributed operating system, Issues in designing a distributed operating system. **Message Passing:** Introduction, Desirable feature of good message-passing system, Issues in IPC by message passing, Synchronization, Buffering, Multidatagram messages, Encoding and decoding of message data, Process addressing, Failure handling, Group communication.					

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**
Remote Procedure Calls: Introduction, Basic RPC operation, Parameter passing, Asynchronous RPC, The RPC model, Transparency of RPC, Implementing RPC mechanism, Stub generation, RPC messages, Marshaling arguments and results, Server management, Parameter-passing semantics, Call semantics, Communication protocol for RPC. **Distributed Shared Memory:** Introduction, General architecture of DSM systems, Design and implementation issues of DSM, Granularity, Structure of shared memory space, Consistency models, Replacement strategy, Thrashing.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Synchronization: Introduction, Clock synchronization, Berkeley algorithm, Lamport's logical clock, Event ordering, Mutual exclusion, Election algorithms – Traditional election algorithms, Elections in wireless environments **Process Management:** Introduction, Process Migration (Code Migration) – Desirable features of a good process migration mechanism, process migration mechanisms, process migration in heterogeneous systems, advantages of process migration , Reasons for migrating code, models for code migration, migration and local resources. **Threads-** Motivations for using threads, Models for organizing threads, Issues in designing a threads package, Implementing a threads packages.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Distributed File Systems: Introduction, Desirable features of a good Distributed file system, File models, File-accessing models, File-sharing semantics, File-catching schemes, File replication. **Naming:** Introduction, Desirable features of a good naming system, Fundamental technologies and concepts, System-oriented names, Object-locating mechanisms.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Resource Management: Introduction, Desirable features of a good global scheduling algorithm, Task assignment approach, Load-balancing approach, Load-sharing approach.		
Text Books:		
1. Pradeep. K. Sinha, "Distributed Operating Systems - Concepts and Design" , PHI, Eastern Economy Edition. 2. Andrew S. Tanenbaum and Maarten Van Steen, "Distributed Systems - Principles and Paradigms", Second edition , PHI, Eastern Economy Edition.		
Reference Books:		
1. George Coulouris, Jean Dollimore and Tim Kindberg, "Distributed Systems - Concepts and Design", Fourth edition, Pearson Education.		

Cloud Computing (Professional Elective Course – IV)					
COURSE OUTLINE					
Course Title:	**Cloud Computing**	**Short Title:**	**CC**	**Course Code:**	

Course description:

This course gives different aspects of Cloud concepts and capabilities across the various Cloud service models including Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS). Cloud computing provides adaptive Virtualisation techniques such as VMWare, Xen, Microsoft Hyper-V. Also provides the awareness of Cloud Platforms in Industry.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	14	42	3

Prerequisite course(s):

Operating Systems, Computer Network

Course objectives:

1.To understand different characteristic of cloud computing and computing platforms.
2. To analyze Principles of Parallel and Distributed Computing.
3.To learn Virtualization.
4. To understand cloud service model.
5. To learn industry case study of cloud computing platform.

Course outcomes:

After successful completion of this course the student will be able to:

1. Describe fundamental knowledge of cloud computing.
2. Analyze the Cloud Principles of Parallel and Distributed Computing.
3. Apply and design suitable Virtualization concept.
4. Analyze cloud computing architecture.
5. Discuss societal issues by addressing Cloud Platforms in Industry.

COURSE CONTENT

Cloud Computing		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Introduction: Cloud computing at a glance, The vision of cloud computing, Defining a cloud, A closer look, The cloud computing reference model, Characteristics and benefits, Challenges ahead, Historical developments, Distributed systems, Virtualization, Web 2.0, Service-oriented computing, Utility-oriented computing, Building cloud computing environments, Application development, Infrastructure and system development, Computing platforms and technologies.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12
Principles of Parallel and Distributed Computing: Eras of computing, Parallel vs. distributed computing, Elements of parallel computing, What is parallel processing?, Hardware architectures for parallel processing, Approaches to parallel programming, Levels of parallelism, Laws of caution, Elements of distributed computing, General concepts and definitions, Components of a distributed system, Architectural styles for distributed computing, Models for interprocess communication, Technologies for distributed computing, Remote procedure call, Distributed object frameworks, Service-oriented computing.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Virtualization: Introduction, Characteristics of virtualized environments, Increased security, Managed execution, Portability, Taxonomy of virtualization techniques, Execution virtualization, Other types of virtualization, Virtualization and cloud computing, Pros and cons of virtualization, Advantages of virtualization, The other side of the coin: disadvantages, Technology examples, Xen: paravirtualization, VMware: full virtualization, Microsoft Hyper-V.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Cloud Computing Architecture: Introduction, The cloud reference model, Architecture, Infrastructure- and hardware-as-a-service, Platform as a service, Software as a service, Types of clouds, Public clouds, Private clouds, Hybrid clouds, Community clouds, Economics of the cloud, Open challenges, Cloud definition, Cloud interoperability and standards, Scalability and fault tolerance, Security, trust, and privacy, Organizational aspect.		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Cloud Platforms in Industry: Amazon web service, Compute services, Storage services, Communication services, Additional services, Google AppEngine, Architecture and core concepts, Application life cycle, Cost model, Observations, Microsoft Azure, Azure core concepts, SQL Azure, Windows Azure platform appliance, Observations.		
Text Books:		
1. R. Buyya,Christian Vecchiola and S Thamarai Selvi Mastering Cloud Computing, Tata McGraw-Hill		
Reference Books:		
1. Anthony T.Velte, Toby J.Velte and Robert E, Cloud Computing – A Practical Approach, TMH 2010 2. Michael Miller, Cloud Computing – Web based Applications, Pearson Publishing, 2011		

Human Computer Interaction (Professional Elective Course – IV)					
COURSE OUTLINE					
Course Title:	**Human Computer Interaction**	**Short Title:**	**HCI**	**Course Code:**	
Course description:					
Human–computer interaction is a specialty in many fields, and is therefore multidisciplinary, but it has an intrinsic relationship as a subfield to computer science. Most interactive computing systems are for some human purpose and interact with humans in human contexts.					
Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	3	**15**	**42**	**3**	
Prerequisite course(s):					
Software Engineering					
Course objectives:					
1. To design effective and usable Human Computer Interfaces. 2. To describe and apply core theories from the field of HCI. 3. To Learn the concepts of Interaction Design 4. To learn the Software process used for HCI					
Course outcomes:					
After successful completion of this course the student will be able to:					
1. Evaluate the basics of human and computational abilities and limitations. 2. Inculcate basic theory, tools and techniques in HCI. 3. Apply the fundamental aspects of designing and evaluating interface. 4. Apply appropriate HCI techniques to design systems that are usable by people 5. Design the HCI Software process.					
COURSE CONTENT					
Human Computer Interaction		**Semester:**	**VII**		
Teaching Scheme:		**Examination Scheme:**			
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**		
		Duration of ESE:	**03 hours**		
		Internal Sessional Exam (ISE):	**40 marks**		
Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**			
The Human: Input Output Channels, Human Memory, Thinking, Emotion, Individual Differences, Psychology and the design of interactive systems.					
Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**			
The Computer: Introduction, Text entry devices, Positioning, pointing and drawing, Display devices, Devices for virtual reality and 3D interaction, Physical controls, sensors and special devices, Design Focus: Readability of text, Memory, Processing and networks					
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**			

The Interaction: Introduction, Models of interaction, Frameworks and HCI, Ergonomics, Interaction styles, Elements of the WIMP interface, Interactivity, The context of the Interaction, Experience, engagement and fun, Paradigms for interaction

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12

Interaction Design Basics: Introduction, What is design? , The process of design, User focus: Design Focus: Cultural probes, Scenarios, Navigation design: Design Focus: Beware the big button trap, Design Focus: Modes, Screen design and layout: Design Focus: Alignment and layout matter, Design Focus: Checking screen colors, Iteration and prototyping

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

HCI in the Software Process: Introduction: The software life cycle, Usability engineering, Iterative design and prototyping: Design Focus: Prototyping in practice, Design rationale.
Design rules: Introduction, Principles to support usability, Standards, Guidelines, Golden rules and heuristics, HCI patterns

Text Books:

1. Alan J, Dix. Janet Finlay, Rusell Beale, "Human Computer Interaction", Pearson Education, 3rd Edition, 2004, ISBN 81-297-0409-9

Reference Books:

1. Jenny Preece, Rogers, Sharp, “Interaction Design-beyond human-computer interaction”, WILEY-INDIA, ISBN 81-265-0393-9
2. Jonathan Lazar, Jinjuan Feng, Harry Hochheiser, “Research Methods in Human-Computer Interaction", Third Edition, Morgan Kaufmann, 2017, ISBN: 9780128053904.
3. Mary Beth Rosson and John M. Carroll, “Usability Engineering: Scenario-Based Development of Human-Computer Interaction”, Morgan Kaufmann, 2001

Human Resource Management (Open Elective Course – III)					
COURSE OUTLINE					
Course Title:	**Human Resource Management**	**Short Title:**	**HRM**	**Course Code:**	
Course description:					
This course helps the students to develop an understanding of the concept & techniques of essential functions of human resource management. This course will use and focus on Indian experiences and approaches for human resource management.					
Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	3	**14**	**42**	**3**	
Prerequisite course(s):					
Course objectives:					
1. To know the function, objective and principle policies of HRM. 2. To understand different strategies, planning and challenges of HRM. 3. To gain knowledge for the nature of job analysis. 4. To know the recruitment process and evaluation of selection process. 5. To understand ethical issues and ethical dilemmas in HRM.					
Course outcomes:					
After successful completion of this course the student will be able to:					
1. Explain policies and principles of Human Resource Management. 2. Define strategy of management and planning of HRM. 3. Determine job analysis, design and evaluation of HRM. 4. Use their right talent in recruitment process. 5. Measure ethical issues, audit and evaluation in Human Resource Management.					
COURSE CONTENT					
Human Resource Management			**Semester:**	**VII**	
Teaching Scheme:			**Examination Scheme:**		
Lectures:	**3 hours/week**		**End Semester Exam (ESE):**	**60 marks**	
			Duration of ESE:	**03 hours**	
			Internal Sessional Exam (ISE):	**40 marks**	
Unit–I:		**No. of Lectures: 09 Hours**		**Marks: 12**	
Introduction to Human Resource Management: Nature of HRM, Functions & Objectives of HRM, Personal policies and principles of HRM, HRM models: The Fombrun- Tichy and Devanna Model, The Harvard Model, The Guest Model, The Warwick Model, The Ulrich Model. Jobs and Careers in HRM: HR Specialist, HR Manager, Head-HR, HR Business Partner, HR Shared Services Expert.					
Unit–II:		**No. of Lectures: 09 Hours**		**Marks: 12**	
Strategy Management and Planning of HRM: Strategic Management, Strategic Management					

Process, Strategic Human Resource Management (SHRM), Strategic HRM versus Conventional HRM, Benefits of Strategic HRM, Challenges of Strategic HRM. Nature of HRP, Importance of HRP, Factors affecting HRP, Barriers to HRP.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Job Analysis, Design and Evaluation: Nature of Job Analysis, Job Analysis and Competitive Advantage, The Process of Job Analysis, Job Analysis and Strategic HRM, Potential Problems with Job Analysis. Job Design, History of Job Design, Significance of Job Design, Factors Affecting Job Design, Job Design Approaches. Job Evaluation: Scope, Process, Pitfalls and Alternatives.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Recruiting and Selecting Right Talent: Nature of Recruitment, Factors Governing Recruitment, Recruitment Process, Evaluation and Control, Philosophies of Recruiting. Selecting Right Talent: Nature of Selection, Selection Process, Barriers to Effective Selection, Evaluation of Selection Process.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Ethical Issues, Audit and Evaluation in HRM: Sources of Ethics, Importance of Ethics, Ethical Dilemmas, Ethical Issues in HRM, Managing Ethics. Nature and Need of HR Evaluation, Principles of Evaluation, Evaluation Framework, Approaches to Evaluation.		
Text Books:		
1. K. Aswathappa, "Human Resource Management Text and Cases", Eight Edition, Tata McGraw Hill Education.		
Reference Books:		
1. Raymond Noe, Raymond Andrew Noe, John Hollenbeck, Barry Gerhart, Patrick M. Wright, *"*Humna Resource Management*",* McGraw-Hill Irwin. 2. DeCenzo, David A. and Robbins, Stephen P., ― Fundamentals of Human Resource Management‖, John Wiley and Sons, Inc. New York. 3. Human Resource Management, Text & Cases by Dr. V.S.P Rao - Excel Books.		

Industrial Engineering (Open Elective Course – III)

COURSE OUTLINE

Course Title:	**Industrial Engineering**	**Short Title:**	**IE**	**Course Code:**	

Course Description:

Industrial engineering is actually a far-ranging profession that focuses on optimizing complex processes or systems by reducing wastefulness in production.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester Credits**
	3	**14**	**42**	**3**

Prerequisite Course(s):

Course Objectives:

1. To introduce the concepts, principles and framework of contents of Industrial Engineering.
2. To acquaint the students with various productivity enhancement techniques.
3. To acquaint the students with different aspects of Production Planning and Control and
4. Facility Design.
5. To introduce the concepts of various cost accounting and financial management practices as applied in industries.
6. To acquaint the students with different aspects of Human Resource activities and Industrial Safety rules.
7. To acquaint students with different aspect of simulation modeling for various industrial engineering\applications.

Course Outcomes:

After successfully completion of this course students will be able to:

1. Apply the Industrial Engineering concept
2. Understand, analyze and implement different concepts involved in method study.
3. Describe the implementation of work and time study at a workplace
4. Analyze various forecasting techniques and their relevance to problems.
5. To identify, formulate and solve engineering problems.

COURSE CONTENT

Industrial Engineering		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I:	**No. of Lectures: 08 hours**	**Marks: 12**

Definition and Role of Industrial Engineering, Types of production systems and

organization structure, Functions of management.
Measurement of productivity: Factors affecting the productivity, Productivity Models and Index, Productivity improvement techniques viz. 5S, Kaizen, TPS, KANBAN, JIT, etc.

Unit – II:	No. of Lectures: 08 hours	Marks: 12

Work Study: Definition, objective and scope of work-study, Human factors in work-study.
Method Study: Definition, objective and scope of method study, work content, activity recording and exam aids.
Charts to record movements: Operation process charts, flow process charts, travel chart, two-handed chart and multiple activity charts. Principles of motion economy, classification of movements, SIMO chart, and micro motion study. Introduction to Value Engineering and Value Analysis.

Unit – III:	No. of Lectures: 09 hours	Marks: 12

Work Measurements: Definition, objectives and uses, Work measurement techniques.
Work Sampling: Need, confidence levels, sample size determinations, random observation, conducting study with the simple problems.
Time Study: Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information, Rating and standard rating, standard performance, scales of rating, factors affecting rate of working, allowances and standard time determination.

Unit – IV:	No. of Lectures: 09 hours	Marks: 12

Introduction: Types of production systems, Need and functions of PPC, Aggregate production planning.
Capacity Planning, ERP: Modules, Master Production Schedule, MRP and MRP-II.
Forecasting Techniques: Causal and time series models, moving average, exponential smoothing, trend and seasonality, Demand Control strategies.
Introduction to Supply Chain Management: Basic terminologies.

Unit – V:	No. of Lectures: 08 hours	Marks: 12

Plant Location: Need and factors influencing plant location,
Plant Layout: Objectives, principles, types of plant layouts, Introduction to Assembly Line Balancing and Layout parameters to evaluate.
Material Handling: Objectives, relation with plant layout, principles. Types and purpose of different material handling equipment, Selection of material handling equipment.
Inventory control and Management: Types of inventories, Need of inventories, terminology, costs, Inventory Models: Basic production models, (with and without shortage and discount), ABC, VED Analysis.

Text Books:

1. M Mahajan, Industrial Engineering and Production Management, Dhanpat Rai and Co.
2. O. P. Khanna, Industrial engineering and management, Dhanpat Rai publication
3. MartendTelsang, Industrial Engineering, S. Chand Publication.
4.Banga and Sharma, Industrial Organization& Engineering Economics, Khanna

publication.
Reference Books:
1. Introduction to Work Study by ILO, ISBN 978-81-204-1718-2, Oxford & IBHPublishing Company, New Delhi, Second Indian Adaptation, 2008. 2. H.B.Maynard, K Jell, Maynard's Industrial Engineering Hand Book, McGraw HillEducation. 3. Askin, Design and Analysis of Lean Production System, Wiley, India 4. Zandin K.B., Most Work Measurement Systems, ISBN 0824709535, CRCPress,2002 5. Martin Murry, SAP ERP: Functionality and Technical Configuration, SAP Press; 3rdNew edition (2010). 6. Barnes, Motion and time Study design and Measurement of Work, Wiley India

Quantitative Reasoning and Problem Solving (Open Elective Course – III)					
COURSE OUTLINE					
Course Title:	**Quantitative Reasoning and Problem Solving**	**Short Title:**	**QRPS**	**Course Code:**	
Course description:					
A quantitative Reasoning is used for various professions to check the numeric ability and problem solving ability of the test taker. There is hardly any vocation in the world where a basic numeric ability is not needed. It is important for any job seeker to understand basic mathematical functions needed in day- to- day commercial operations					

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	14	42	3

Prerequisite course(s):

Course objectives:

1. Use appropriate mathematical and statistical language in oral, written, and graphical forms.
2. Think critically about mathematical models for relationships between different quantities and use those models effectively and accurately to solve problems and reach sound conclusions about them.
3. Interpret and analyze various representations of data.

Course outcomes:

After successful completion of this course the student will be able to:

1. Perform arithmetic calculations on number system, HCF and LCM and age
2. Solve application problems involving Time, Distance, Speed.
3. Calculate Time Taken at varies case.
4. Calculate percentage, average and simple interest.
5. Classify data as categorical or quantitative.

COURSE CONTENT

Quantitative Reasoning and Problem Solving		Semester:	VII
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of EE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	No. of Lectures: 08 Hours	Marks: 12

Number System: Fundamental Concepts, Tests of Divisibility, Factorial of number, Modulus of a number, Greatest integral Value, Multiplication by Short cut method, Division algorithm.
Highest Common Factor and Least Common Factor: Factors and Multiples , Factorization method, Division Method ,HCF and LCM of fractions, HCF and LCM of decimal Fractions.

Problems on Ages : Ratio Based Age Problems, Equation Solving Type Age Problems, Finding Ratio Between Ages

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

Time and Distance: Unit Conversion Time And Distance Problems, Average Speed When Travelling To A Place And Returning, Problems Based On Changing Time And Changing Speed.

Problem on Trains: Important facts and Formulae, Time taken by train to pass pole/standing man / Signal post, relative Speed of trains/ bodies moving in same direction, cross time of trains/bodies moving in opposite direction, Cross time trains/ bodies moving in same direction with different speed, reaching time of two trains/ bodies start at the same time from point A and B towards each other destination.

Problem on Boat: Speed of downstream, Speed of upstream, Speed in still water, Rate of stream, Speed of the man in still water.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Time and Work: Calculate Time to Complete Work by 2 or More People, Equations Based Time and Work Problems, Efficiency Based Time and Work Problems, Calculate Time When Efficiency is Given in Percentage, Calculate Time When Workers Leave in Between, Share of Salary Based on Work.

Pipes and Cisterns: Important Facts and Formulae, Calculate Time Taken to Fill a Tank By 2 or More Pipes, Calculate Time Taken to Fill a Tank With Leakage, Equations Based Pipes and Cistern Problems, Calculate Time Taken When Pipes Are Opened For Different Periods, Calculate Number of Pipes.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Percentage: Concepts of percentage, Results on population, Result on depreciation, Salary Comparison Percentage Problems, Appreciation And Depreciation Based Percentage Problems, Price And Consumption Based Percentage Problems, Set Theory Formula Based Percentage Problems.

Average: Number Series Summation Based Averages, Consecutive Even/Odd Type Problems, Change In Average Based Problems, Multiple Groups Based Average Problems, Distance And Speed Based Averages.

Simple Interest: Important Fact and Formulae, Simple Interest Formula Based Direct Problems, Compound Interest Formula Based Direct Problems, Difference Between Compound And Simple Interests, Direct Problems With Both SI And CI.

Unit–V:	No. of Lectures: 09 Hours	Marks: 12

Data Interpretation: Tabulation, Bar Graph, Pie Chart, Line graph, Problem on data Data Interpretation: Sum and Difference based, Average based questions, percentage based questions.

Text Books:

1. Dr. R.S. Aggarwal "Quantitative Aptitude" S. Chand Publication, Revised Edition 2017

Entrepreneurship Development (Open Elective Course – III)

COURSE OUTLINE

Course Title:	**Entrepreneurship Development**	**Short Title:**	**ED**	**Course Code:**	

Course description:

This Course Aims at Instituting Entrepreneurial skills in the students by giving an overview of, who the entrepreneurs are and what competences are needed to become an entrepreneur.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**14**	**42**	**3**

Prerequisite course(s):

Course objectives:

1. To introduce the aspects of Entrepreneurship.
2. To acquaint with legalities in product development.
3. To know the facets of functional plans.
4. To understand the Entrepreneurial Finance Management.
5. To know about the Launching a Venture and Managing growth.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the aspects of Entrepreneurship
2. Understand the legalities in product development.
3. Understand and apply business plans and marketing strategy.
4. Understand and apply Finance plan.
5. Inculcate managerial skill as an entrepreneur.

COURSE CONTENT

Entrepreneurship Development		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Fundamentals of Entrepreneurship: Entrepreneurship, Resource Organization and Value Creation, Entrepreneurial Traits, Difference between Inventors and Entrepreneurs, Business Model, Entrepreneurship—Mindset, Big Companies Vs Start-ups, Misconceptions and Myths about Entrepreneurship.

Entrepreneurship Development in Emerging Markets: Types of Start-up, Intrapreneurship, Why does One Become an Entrepreneur?, Entrepreneurship as a Career Option, Female Entrepreneurship, Mistakes Start-ups Make, Managing Start-ups during Downturn, Entrepreneurship—Emerging Trends in the Global Knowledge.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

Entrepreneurial Leadership: Entrepreneurial Leadership, Components of Entrepreneurial Leadership.

Creativity and Business Ideas: Creativity and Entrepreneurship, Generating Business Idea-Sources of New Ideas, Techniques for Generating Ideas.

Legal Aspects of Business: Formation of Business Entity, Requirements for Incorporation of a Private/Public Limited Company.

Entrepreneurship and Intellectual Property Rights: Patents Trademarks and Copyrights.

Business Plan: Entrepreneurial Opportunities and Business Plan, Business Plan Drivers, Business Failures.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Marketing Plan: Marketing Research, Benefits of Undertaking Marketing Research**,** Factors Affecting the Decision to Undertake Marketing Research, Scope and Steps Involved in Marketing Research, Industry Analysis, Competitor Analysis, Define Target Market, Market Segmentation, Market Positioning, Building A Marketing Plan, Marketing Mix, Critical Factors For Devising A Market Strategy.

Venture Team And Organizational Plan – Building an Effective Venture Team, Venture Team Development, Designing Organization Structure and Systems, Designing an Effective Organizational Structure.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Insight from Financial Statements: Meaning And Objectives of Financial Statement, Assumptions Underlying Preparation of Financial Statement, Profit and Loss Account/Income Statements, Ratio Analysis.

Financing Venture: Sources of Finance, Seed Funding, Venture Capital Funding, Funding from Banks, Lease Financing, Funding Opportunities for Startups in India.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Launching a Venture: Steps Involved in Launching a Business, Incorporation and Issuance of Stocks, Execute a Stockholders' Agreement, Raise Different Resources Including Finance on Time, Leverage of Intellectual Property, Build a Winning Team, Motivating and Inspiring the Team, Understand Clearly the Technology Trends, Prepare Pilot Testing, Manage Sales by a Clear Understanding—Market Marketing Strategies and Positioning, Record Keeping of Expenses, To-do Checklist—Daily, Weekly and Monthly, Managing Cash, Due Diligence, Scheduling—Implementation Plan.

Managing Growth: Growth Sources, Venture Development Stages, How Fast can a Venture Grow?, Management—Key Factors for Growth, Managerial Issues—Growth of a Venture, Why Entrepreneurs do not Scale up, Tips for Growth of a Venture, Growth Strategies for Ventures.

Start-up to Going Public: What is an IPO?, When to Go for an IPO?, Steps Involved in Issuing an IPO, Selection of Intermediaries to the IPO, Rating of IPOs, Marketing Strategies for IPO, Misconceptions about IPOs.

Text Books:

1. Kumar, Arya, “Entrepreneurship: Creating and Leading an Entrepreneurial Organization”, Pearson 2012.

Reference Books:

1. Hishrich., Peters, “Entrepreneurship: Starting, Developing and Managing a New Enterprise, McGraw-Hill Education Tenth Edition.
2. Charantimath, Poornima, “Entrepreneurship Development and Small Business Enterprises”, Pearson Education, Second Edition.

Compiler Design Lab					
LAB COURSE OUTLINE					
Course Title:	**Compiler Design Lab**	**Short Title:**	**CDL**	**Course Code:**	
Course description:					
Compiler Design Lab course provides a practical approach to build phases of compiler.					
Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	2	**14**	**28**	**1**	
End Semester Exam (ESE) Pattern:		**Practical (PR)**			
Prerequisite course(s):					
Formal Language and Automata Theory					
Course objectives:					
1. To learn LEX and YACC tools. 2. To build Lexical Analyzer and Syntax Analyzer. 3. To build Intermediate-Code Generator. 4. To implement Predictive Parser. 5. To implement Deterministic Finite Automata.					
Course outcomes:					
Upon successful completion of lab Course, student will be able to:					
1. Demonstrate LEX and YACC tools. 2. Design Lexical Analyzer. 3. Design Syntax Analyzer. 4. Design Code Optimization. 5. Design Code Generator					
LAB COURSE CONTENT					
Compiler Design Lab		**Semester:**	**VII**		
Teaching Scheme:		**Examination scheme:**			
Practical:	**2 hours/week**	**End Semester Exam (ESE): (PR)**	**25 marks**		
		Internal Continuous Assessment (ICA):	**25 marks**		

Concerned faculty member should suitably frame THREE laboratory assignments from Group - A and THREE Laboratory assignments from Group – B from the following list.

Group A

1. Implement a lexical analyzer for a subset of C using LEX Implementation should support Error handling
2. Implement a lexical analyzer of identification of numbers (Numbers can be binary, octal, decimal, hexadecimal, float or exponential)
3. Write an ambiguous CFG to recognize an infix expression and implement a parser that

recognizes the infix expression using YACC. Provide the details of all conflicting entries in the parser table generated by LEX and YACC and how they have been resolved
4. Implement a Calculator using LEX and YACC.
5. Implementation of Syntax Tree

Group B

1. Implementation of Context Free Grammar
2. Design of a Predictive parser
3. Implementation of code generator
4. Implementation of code optimization for Common sub-expression elimination, Loop invariant code movement.
5. Implement Deterministic Finite Automata

Note: - Use of Open Source Software/Tool/Technology is recommended for laboratory assignments of the concern subject.

Text Books:

1. J. R. Levine, T. Mason, D. Brown, "Lex &Yacc", O'Reilly, 2nd Edition
2. Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D Ullman- "Compilers- Principles, Techniques and Tools", 2nd edition, Pearson, 2014.

Reference Books:

1. K. Cooper, L, Torczon, "Engineering a Compiler", Morgan Kaufinann Publishers
2. K. Louden, "Compiler Construction: Principles and Practice", Cengage Learning
3. S. Chattopadhyay, "Compiler Design", Prentice-Hall of India, 2005.

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignments.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification.
Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.

Advanced Technology Lab - I					
LAB COURSE OUTLINE					
Course Title:	**Advanced Technology Lab - I**	**Short Title:**	**ATL - I**	**Course Code:**	
Course description:					
The course focuses on practical hands-on of recent technologies.					

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	**1**	**14**	**14**	**2**
Laboratory	**2**	**14**	**28**	

End Semester Exam (ESE) Pattern:	**Practical (PR)**

Prerequisite course(s):

Programming Language
Database Management Systems
Computer Network

Course objectives:

To enhance competency by undertaking laboratory assignments using Full Stack.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Break down real world problems / application.
2. Demonstrate Full Stack development.
3. Design Full Stack based applications.
4. Decide tools for Full Stack development.
5. Develop Full Stack based applications.

LAB COURSE CONTENT

Advanced Technology Lab - I		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme:**	
Theory:	**1 hour/week**	**End Semester Exam (ESE): (PR)**	**25 marks**
Practical:	**2 hours/week**	**Internal Continuous Assessment (ICA):**	**25 marks**

Concerned faculty member should suitably frame Three Laboratory assignments using Full Stack (Front End, Back End and Database) by considering the technological aspects, utility and recent trends. The assignments should be based on real world problems / application. The assignments and / or tools in the Full Stack may be framed per individual student or group of students. The assignments may also be based on professional elective course opted by individual student or group of students in the current semester, but must be based on real world problems / application. For better understanding of various facets of different Full Stacks, it is expected that the assignments should be implemented using more than one Full Stacks.

Following are the suggested list of tools but not limited to:

Operating System

- 64-bit Open source Linux or its derivative or Windows

Programming Languages: C++ / C# / JAVA / PYTHON / R

Programming tools:

- Front End: Java / Perl / PHP / Python / Ruby / .NET / HTML / Wordpress / Drupal / Javascript / JQuery / Laravel Blade / MeteorJS / AngularJS / ReactJS / VueJS etc.
- Backend: C / C++ / Java / Java Spring / Java Swing / Node JS / Ruby / Python / .NET / PHP/ Laravel etc.
- Database: MongoDB / MYSQL / Oracle / SQL Server, Database Connectivity: ODBC / JDBC etc.

Some of the Full Stack:

- LAMP / WAMP stack: JavaScript - Linux - Apache - MySQL - PHP
- LEMP / WEMP stack: JavaScript - Linux - Nginx - MySQL - PHP
- MEAN stack: JavaScript - MongoDB - Express - AngularJS - Node.js
- Django stack: JavaScript - Python - Django - MySQL
- Ruby on Rails: JavaScript - Ruby - SQLite - Rails

For each laboratory assignment, Software Engineering approach with proper documentation is required.

Note: - Use of Open Source Software/Tool/Technology is recommended for laboratory assignments of the concern subject.

Text Books:

Reference Books:

Online web Resources

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignments.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification.

Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.

Project (Stage – I)

LAB COURSE OUTLINE

Course Title:	**Project (Stage – I)**	**Short Title:**	**PROJ-SI**	**Course Code:**	

Course description:

Project represents the culmination of study towards the Bachelor of Engineering degree. The project offers the opportunity to apply and extend material learned throughout the program. The emphasis is necessarily on facilitating student learning in technical, project management and presentation spheres.

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	12	**14**	**168**	**6**

End Semester Exam (ESE) Pattern:	**Oral (OR)**

Prerequisite course(s):

Course objectives:

1. To understand the basic concepts & broad principles of projects.
2. To understand the value of achieving perfection in project implementation & completion.
3. To apply the theoretical concepts to solve problems with teamwork and multidisciplinary approach.
4. To demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Demonstrate a sound technical knowledge of their selected project topic.
2. Undertake problem identification, formulation and solution.
3. Design engineering solutions to complex problems utilizing a systems approach.
4. Conduct an engineering project
5. Demonstrate the knowledge, skills and attitudes of a professional engineer.

LAB COURSE CONTENT

Project (Stage – I)		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Practical:	**12 hours/week**	**End Semester Exam (ESE): OR**	**50 marks**
		Internal Continuous Assessment (ICA):	**50 marks**

At the final year the students shall carry out a project in a group of maximum up to 5 students. The project work spans both the semesters. By the end of Semester –VII the students shall complete the partial work, and by the end of Semester –VIII the students shall complete remaining part of the project. Assessment for the project shall also include presentation by the students. Each teacher can guide maximum 04 groups of projects.

The students should take project work, as specified in the curriculum, based on the knowledge acquired by the students during the degree course till Semester – VI and/or during Internship. The project may be either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department. The work may also be Study/Survey/Design or R&D work. The work may also be on specified task or project assigned to the students during Internship.

Project (Stage – I) may involve literature survey, problem identification, design methodology, collection of data etc. The project work shall involve sufficient work so that students get acquainted with different aspects of design and analysis. Approximately more than 50% work should be completed by the end of Semester – VII. Each student group should submit partial project report in the form of thermal bound at the end of Semester –VII. Assessment for the project shall also include presentation by the students.

Each student group is required to maintain separate log book for documenting various activities of the project.

Suggestive outline for the partial project report is as follows.

Abstract

Chapter 1. Introduction

- Background
- Motivation
- Problem Definition
- Scope
- Objective
- Selection of Life cycle Model for Development
- Organization of Report
- Summary

Chapter 2. Project Planning and Management

- Feasibility Study
- Risk Analysis
- Project Scheduling
- Effort Allocation
- Cost Estimation
- Summary

Chapter 3. Analysis

- Requirement Collection and Identification
- H/w and S/w Requirement (Data, Functional and Behavioral)
- Functional and non-Functional Requirements
- Software Requirement's Specification (SRS)
- Summary

Chapter 4. Design

- System Arch
- Data Flow Diagram
- UML Diagrams (Use case, Class, Sequence, Component, Deployment, State chart, Activity diagram etc.)
- Summary

Chapter 5. Conclusion & Future Work

Bibliography

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Appendix

Guide lines for ICA:

The Internal Continuous Assessment (ICA) for project shall be based on continuous evaluation of students' performance, active participation, knowledge / skill acquired throughout semester and presentation by the students. The assessment shall be done jointly by the guide and departmental committee. A three-member departmental committee including guide, appointed by Head of the department, shall be constituted for the assessment. The assessment for Project (Stage – I) in Semester – VII shall be as per the guidelines given in Table – A.

Table – A

		Assessment by Guide					Assessment by Departmental Committee		
Sr. No.	Name of the Student	Attendance / Participation	Problem Identification / Project Objectives	Literature Survey	Methodology / Design	Report	Depth of Understanding	Presentation	Total
	Marks	5	5	5	5	5	10	15	50

Guidelines for ESE:

In End Semester Examination (ESE), the student may be asked for presentation / demonstration and questions on Project. Evaluation will be based on answers given by students in oral examination.

Essence of Indian Traditional Knowledge

Course objective:
The course aims at imparting basic principles of thought process, reasoning and inferencing, sustainability is at the core of Indian traditional knowledge system connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. The course focuses on introduction to Indian knowledge systems, Indian perspective of modern scientific world-view, and basic principles of yoga and holistic health care system, Indian artistic tradition.

Outcomes:
Ability to understand, connect up and explain basics of Indian traditional knowledge in modern scientific perspective.

Course Contents:
Introduction to:

1. Ayurveda, Charaka Samhita, Sushruta Samhita
   Principles and Terminology: Vatha, Pitha, Kapha, Ether, Earth, Water, fire and Air Tatva, Influence of these on human health.
2. Architecture: Temple Architecture, Indo – Islamic Architecture, Mughal Architecture, Indian Rock Cut Architecture, Vastu Shastra.
3. Importance of Yoga for Physical and Mental health, Yoga Sutras of Patanjali, Meditation, International day of Yoga.
4. Indian Classical Music, Hindustani and Carnatic Music, Raga, Tala, Dhrupad, Khyal, Tarana and Thumri, Sangitaratnakara, Work of Tansen, Purandara Dasa, Bhimsen Joshi, Ustad Bismillah Khan, Bal Gandharva etc.
   Folk Music and Dances such as Rajasthani, Marathi, Gujrati, Punjabi etc.
5. Indian Classical Dances: Shastriya Nritya, Natya Shastra, Bharatanatyam, Kathak, Kuchipudi, Odissi, Kathakali, Sattriya, Manipuri, Mohiniyattam and Chhau dance forms.

References:

1. Amit Jha, “Traditional knowledge system in India”, Atlantic Publisher, ISBN 978812691223
2. Basanta Kumar Malhotra, “Traditional Knowledge System and Technology in India”, Pratibha Prakashan, ISBN 8177-023101
3. Nitin Singhania, “Indian Art and Culture”, McGraw Will Publication.
4. Dr. Bramhand Tripathi, “Charak Sanhita”, Chaukhambha Surbharti Prakashan, ISBN: 9381-4847-59
5. Dr. Anantram Sharma, “Sushrut Samhita”
6. Valiatham M.S., “An Introduction to Ayurveda” Orient Bkackswan Publication.
7. Valiathan M.S., “The legacy of Charaka” University Press.
8. Valiathan M.S., “The legacy of Susruta” University Press.
9. Garg Maheshwari, “Ancient Indian Architecture”, CBS Publisher and Distributors
10. Sharmin Khan, “History of Indian Architecture”, CBS Publisher and Distributors.

11. Bindia Thapar, Surat ku. Manto, Suparana Bhalla, “Introduction to Indian Architecture”, Periplus Editions Ltd.
12. Vijay Prakash Singh, “An Introduction to Hindustani Classical Music”, Lotus Publisher
13. Leeta Venkataraman, Avinash Pasricha, “Indian Classical Dance” Lustre Publisher
14. Shovana Narayan, “Indian Classical Dances” New Dawn Press
15. Kapila Vatsyayan, “Indian Classical Dance”, Ministry of Information and Broadcasting, Govt of India.
16. Mahadevan Ramesh, “A Gentle introduction to Carnatic Music”, Oxygen books Publisher.

Kavayitri Bahinabai Chaudhari

NORTH MAHARASHTRA UNIVERSITY,

JALGAON (M.S.)

Final Year Engineering

(Computer Engineering / Information Technology)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
3rd Cycle

COURSE OUTLINE

Semester - VIII

W.E.F. 2021 – 22

Cyber Security					
COURSE OUTLINE					
Course Title:	**Cyber Security**	**Short Title:**	**CS**	**Course Code:**	
Course description:					
Cyber Security course focuses on cyber threats and cyber security that provides the much needed awareness in the times of growing cybercrime episodes.					
Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	3	**14**	**42**	**3**	
Prerequisite course(s):					
Computer Network					
Course objectives:					
1. To understand Cybercrime and Cyberoffenses. 2. To understand Cybercrime through portable devices. 3. To understand tools and methods used in Cybercrime. 4. To understand Phishing and Identity theft. 5. To understand Computer Forensics.					
Course outcomes:					
After successful completion of this course the student will be able to:					
1. Determine the act of Cyberoffenses. 2. Determine the Cybercrime through portable devices. 3. Determine the methods used in Cybercrime. 4. Determine Phishing and Identity theft. 5. Describe Computer Forensics.					
COURSE CONTENT					
Cyber Security		**Semester:**	**VIII**		
Teaching Scheme:		**Examination scheme:**			
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**		
		Duration of ESE:	**03 hours**		
		Internal Sessional Exam (ISE):	**40 marks**		
Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**			
Introduction to Cybercrime: Introduction, Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals?, Classifications of Cybercrimes **Cyberoffenses: How Criminals Plan Them:** Introduction, How Criminals Plan the Attacks, Social Engineering, Cyberstalking, Cybercafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.					
Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**			
Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless					

Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile device related security issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers,, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Phishing and Identity Theft: Introduction, Phishing, Identity Theft (ID Theft) **Understanding Computer Forensics:** Introduction, Historical Background of Cyberforensics, Digital Forensics Science, The Need for Computer Forensics, Cyberforensics and Digital Evidence, Forensics Analysis of E-Mail		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Computer Forensics: Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Antiforensics		
Text Books:		
1. Nina Godbole and Sunil Belapure, “Cyber Security”, Wiley India Publication, 2014		
Reference Books:		
1. Nina Godbole , Information Systems Security , Wiley India Publication 2. V.K. Pachghare, Cryptography and Information security, PHI, Second edition		

Soft Computing (Professional Elective Course – V)

COURSE OUTLINE

Course Title:	**Soft Computing**	**Short Title:**	**SC**	**Course Code:**	

Course description:

Soft computing refers to a consortium of computational methodologies. Some of its principal components include Fuzzy Logic, Neural Networks, and Genetic algorithms, all having their roots in Artificial Intelligence. In today's highly integrated world, when solution to problems are cross-disciplinary in nature, soft computing promises to become a powerful means for obtaining solution to problems quickly.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**15**	**42**	**3**

Prerequisite course(s):

Artificial Intelligence, Neural Networks

Course objectives:

1. To know the basics behind the Design and development intelligent systems in the framework of soft computing
2. To acquire knowledge of Neural Networks
3. To acquire knowledge of Fuzzy sets and Fuzzy Logic
4. To acquire knowledge of Genetic algorithm
5. To explore the applications of soft computing

Course outcomes:

After successful completion of this course the student will be able to:

1. Apply soft computing methodologies includes neural network
2. Apply soft computing methodologies includes fuzzy logic
3. Apply soft computing methodologies includes genetic algorithm
4. Apply soft computing methodologies includes hybrid system
5. Design of certain scientific and commercial application using soft computing approach

COURSE CONTENT

Soft Computing		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Soft Computing: Soft Computing, Hard computing, Three Technologies of Soft Computing, Neural Networks, Fuzzy Logic and Genetic Algorithms, Fundamentals of Neural Networks: Human Brain, Model of Artificial Neuron, Neural Network Architectures, Characteristics of Neural Networks, Learning Methods. Backpropagation Networks: Architecture of a Backpropagation Network

Unit–II:	No. of Lectures: 09 Hours	Marks: 12
Basic concepts of fuzzy logic: Fuzzy versus Crisp, Crisp sets: operations, properties, Fuzzy sets: Membership function, basic fuzzy set operations, properties of fuzzy sets, Crisp relations: Cartesian product, Fuzzy relations: fuzzy Cartesian product, Fuzzy Systems: Crisp logic: Laws of propositional logic, Inference in propositional logic, Fuzzy logic: fuzzy quantifier, fuzzy inference, Fuzzy rule based system		

Unit–III:	No. of Lectures: 08 Hours	Marks: 12
Genetic Algorithms: fundamental, history, basic concepts, creation of Offsprings, Working principal, Encoding: binary encoding, Octal encoding, Hexadecimal encoding, Permutation encoding, Value encoding, Tree encoding, Fitness function, Reproduction: Roulette wheel selection, Boltzman selection, Tournament selection, Rank selection, steady state selection.		

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12
Genetic Modeling: Inheritance operators, Cross over: single site, Two point, Multi point, Uniform, Matrix, cross over rate, Inversion and deletion: Inversion, deletion and duplication, deletion and regeneration, Segregation, Cross over inversion, Mutation operator: Mutation, Mutation rate, Bitwise operators: One's complement operator, Logical Bit-wise operator, Shift operator, Bit-wise operators Used in GA, Generational cycle, Convergence of Genetic algorithm, difference and similarities between GA and other traditional methods, Advances in GA		

Unit–V:	No. of Lectures: 08 Hours	Marks: 12
Hybrid Systems and Applications: Sequential hybrid systems, auxiliary hybrid systems, Embedded hybrid systems, Neuro-Fuzzy hybrid, Neuro-Gentic hybrid, fuzzy-Genetic hybrid, GA based backpropagtion networks: coding, weight extraction, fitness function, reproduction, convergence, Applications of neural networks in character recognition and classification of soil, Applications of fuzzy logic in Greg viot's fuzzy cruise controller and air conditioner controller		

Text Books:

1. S. Rajsekaran and G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications" , Prentice Hall of India

Reference Books:

1. S.N. Sivanandam- "Principles of Soft Computing", 2nd Edition, Wiley India- ISBN-9788126527410
2. S R Jang, CT Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing" , PHI PVT LTD, ISBN 0-13-261066-*3*.
3. De Jong , "Evolutionary Computation: A Unified Approach", Cambridge (Massachusetts): MIT Press. ISBN: 0-262-04194-4. 2006
4. Maurice Clerc, "Particle Swarm Optimization", ISTE, Print ISBN:9781905209040 |Online ISBN:9780470612163 |DOI:10.1002/9780470612163
5. Siman Haykin, "Neural Networks", Prentice Hall of India, ISBN: 0-7923-9475-5
6. Timothy J. Ross, "Fuzzy Logic with Engineering Applications" , Wiley India, ISBN: 978-0-470-74376-8

Advanced Operating System (Professional Elective Course – V)					
COURSE OUTLINE					
Course Title:	**Advanced Operating System**	**Short Title:**	**AOS**	**Course Code:**	
Course description:					
The aim of this course is to introduce the students, the basic foundation in the design of advanced operating systems. The emphasis of the course is on various alternative approaches to the solution of the problems encountered in the design of advanced operating systems.					
Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	3	**14**	**42**	**3**	
Prerequisite course(s):					
Operating System Computer Network					
Course objectives:					
1. To acquire the basic knowledge of Advanced Operating Systems and architectures of distributed operating system. 2. To gain knowledge of Distributed deadlock detection algorithms. 3. To know the distributed scheduling concept and fault tolerance. 4. To understand the resource security with its protection and data security. 5. To study Multiprocessor system architectures and multiprocessor operating systems.					
Course outcomes:					
After successful completion of this course the student will be able to:					
1. Describe the concept of advanced operating systems and architectures of distributed systems. 2. Explain Distributed deadlock detection mechanisms and agreement protocols for distributed systems. 3. Discuss about the distributed scheduler with key issues such as load distribution & load balancing along with failure and recovery in distributed system. 4. Summarize the concept of fault tolerance, resource security and protection. 5. Describe Cryptography and multiprocessor system architectures along with multiprocessor operating systems.					
COURSE CONTENT					
Advanced Operating System			**Semester:**	**VIII**	
Teaching Scheme:			**Examination scheme:**		
Lectures:	**3 hours/week**		**End Semester Exam (ESE):**		**60 marks**
			Duration of ESE:		**03 hours**
			Internal Sessional Exams (ISE):		**40 marks**
Unit–I:		**No. of Lectures: 08 Hours**		**Marks: 12**	
Overview: Introduction, Functions of an operating system, Design approaches, Why advanced					

operating systems, Types of advanced operating systems,
Architecture of Distributed Operating Systems: Introduction, Motivations, System Architecture Types, Distributed Operating Systems, Issues in Distributed Operating Systems, Communication Networks, Communication Primitives,

Unit–II:	No. of Lectures: 08 Hours	Marks: 12

Distributed Deadlock Detection: Introduction, Preliminaries, Deadlock handling strategies in distributed systems, Issues in deadlock detection and resolution, Control organizations for distributed deadlock detection, Centralized deadlock detection algorithms, Distributed deadlock detection algorithms, Hierarchical deadlock detection algorithms, Perspective.
Agreement Protocols: Introduction, The system model, A classification of agreement problems, Solutions to the Byzantine agreement, Applications of agreement algorithms,

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Distributed Scheduling: Introduction, Motivation, Issues in load distributing, Components of load distributing algorithm, Stability, Load distributing algorithms, Performance comparison, Selecting a suitable load sharing algorithm, Requirements for load distributing, Task migration, Issues in task migration,
Recovery: Introduction, Basic concepts, Classification of failures, Backward and forward error recovery, Backward-error recovery - basic approaches, Recovery in concurrent systems, Consistent set of checkpoints, Synchronous checkpointing and recovery, Asynchronous checkpointing and recovery,

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12

Fault Tolerance: Introduction, Issues, Atomic action and committing, Commit protocols, Nonblocking Commit protocols, Voting protocols, Dynamic voting protocols, The majority based dynamic voting protocols, Dynamic vote reassignment protocols, Failure resilient processes, Reliable communication.
Resource security and protection - Access and flow control: Introduction, Preliminaries, The access matrix protocol, Implementation of the access matrix, Safety in the access matrix model, Advanced models of protection,

Unit–V:	No. of Lectures: 09 Hours	Marks: 12

Data Security - Cryptography: Introduction, A model of cryptography, Conventional cryptography, modern cryptography, Private key cryptography: Data encryption standard, Public key cryptography, Multiple encryption, Authentication in distributed systems.

Multiprocessor System Architectures: Introduction, Motivations for multiprocessor systems, Basic multiprocessor system architectures, Interconnection networks for multiprocessor systems, Caching, Hypercube architectures.

Multiprocessor operating systems: Introduction, Structures of multiprocessor operating systems, Operating system design issues, Threads, Process synchronization, Processor scheduling, Memory management – The Mach operating system

Text Books:
1. Mukesh Singhal and Niranjan G. Shivaratri, " Advanced Concepts in Operating Systems – Distributed, Database, and Multiprocessor Operating Systems" , Tata McGraw-Hill Edition
Reference Books:
1. Pradeep. K. Sinha, "Distributed Operating Systems - Concepts and Design", PHI, Eastern Economy Edition. 2. Andrew S. Tanenbaum and Maarten Van Steen, "Distributed Systems - Principles and Paradigms", Second edition , PHI, Eastern Economy Edition.

Mobile Computing (Professional Elective Course – V)					
COURSE OUTLINE					
Course Title:	**Mobile Computing**	**Short Title:**	**MC**	**Course Code:**	

Course description:

Fundamentals of Mobile Computing explains revolutionary and rapidly evolving paradigm for Computing: mobile users seamlessly interacting with wireless devices embedded in environment. Recognizing the increasing dominance mobile devices, networks and applications, this mobile centric perspective gives today's student the inside track on tomorrow's solutions and opportunities.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	14	42	3

Prerequisite course(s):

Computer network.

Course objectives:

1. Student will learn basic concepts of mobile computing.
2. Students will understand mobility management in wireless network.
3. Student will explore to mobile middleware and its types in mobile environment.
4. Students will understand various security issue in mobile network

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the basic concepts of mobile computing
2. Understand the data dissemination and management in mobile computing
3. Analyze various mobile middleware techniques used in mobile computing
4. Evaluate various security approaches used in wireless network.
5. Use various security approaches in mobile environment.

COURSE CONTENT

Mobile Computing		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Mobile Adaptive Computing: What Is Mobile Computing? Adaptability—The Key to Mobile Computing, Transparency, Constraints of mobile computing environments, Application-aware adaptation, Mechanisms for Adaptation: Adapting functionality, Adapting data

How to Develop or Incorporate Adaptations in Applications?: Where can adaptations be performed? Support for Building Adaptive Mobile Applications: Odyssey, Rover

Mobility Management, Location Management Principles and Techniques, Registration area–based location management, Location Management Case Studies, PCS location management

scheme, Mobile IP

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

Data Dissemination and Management: Challenges, Data Dissemination: Bandwidth allocation for publishing Broadcast disk scheduling, Mobile Data Caching: Caching in traditional distributed systems, Cache consistency maintenance , Performance and architectural issues, Mobile Cache Maintenance Schemes: A taxonomy of cache maintenance schemes, Cache maintenance for push-based information dissemination , Broadcasting invalidation reports, Disconnected operation , Asynchronous stateful (AS) scheme , To cache or not to cache? Mobile Web Caching: Handling disconnections, Achieving energy and bandwidth efficiency. Context-Aware Computing: Ubiquitous or Pervasive Computing, What Is a Context? Various Definitions and Types of Contexts: Enumeration-based, Role-based, Context-Aware Computing

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Introduction to Mobile Middleware: What is Mobile Middleware? Adaptation, Agents, Service Discovery, Middleware for Application Development: Adaptation and Agents, Adaptation: The spectrum of adaptation, Resource monitoring, Characterizing adaptation strategies, An application-aware adaptation architecture: odyssey A sample odyssey application, More adaptation middleware, Mobile agents, Service Discovery Middleware: Finding Needed Services: services, more on Discovery and Advertisement protocols, Garbage Collection, Eventing.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Wireless Security: Traditional Security Issues, Mobile and Wireless Security Issues, Mobility, Problems in Ad Hoc Networks, Additional Issues: Commerce, Additional Types of Attacks, Approaches to Security: Limit the Signal: Wire integrity and tapping, Physical limitation, Encryption: Public and private key encryption, Computational and data overhead, Integrity Codes: Checksum versus cryptographic hash, Message authentication code (MAC), Payload versus header, Traffic analysis, IPSec, Authentication header (AH), Encapsulating security payload (ESP), Security-Related Mechanisms: Authentication protocols, AAA, Special Hardware

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Security in Wireless Local Area Networks: Basic Idea, Wireless Alphabet Soup, Wired-Equivalent Privacy (WEP):WEP goals, WEP data frame, WEP encryption, WEP decryption, WEP authentication, WEP flaws, WEP fixes, WPA,
Security in Wide Area Networks: CDMA, GSM: GSM authentication, GSM Encryption, Problems with GSM Security: session life, Weak encryption Algorithm, Encryption between mobile host and base station only, Limits to secrete Key, The four generation of wireless:1G-4G

Text Books:

1. Frank Adelstein, Sandeep K.S Gupta , “Fundamentals of Mobile & Pervasive Computing ”,

TMH (2005)
Reference Books:
1. Asoke K Talukder , Hasan Ahmed , RoopaYavagal, “Mobile Computing: Technology, Applications and Service Creation”, TMH (2010) 2. Jochen Schiller , "Mobile Communications," Addison-Wesley (2009)

Business Analytics and Intelligence (Professional Elective Course – V)

COURSE OUTLINE

Course Title:	**Business Analytics and Intelligence**	**Short Title:**	**BAI**	**Course Code:**	

Course Description:

This course aims at providing information system with comprehensive knowledge of business intelligence principles and techniques and expose students to the frontiers of BI-intensive BIG data computing and information system.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**14**	**42**	**3**

Prerequisite Course(s):

1. Fundamentals of Data Mining.
2. Knowledge of Artificial Intelligence

Course Objectives:

1. To introduce concept of computerized decision support system, data analytics and business intelligence.
2. To know the impact of business reporting, information visualization and dashboards.
3. Select software tools for knowledge management systems in business organizations
4. To understand the fundamentals of Big Data Analytics.
5. To know the impacts of analytics in organizations.

Course Outcomes:

After successful completion of this course the student will be able to:

1. Understand the aspects of computerized decision support system, data analytics and business intelligence.
2. Understand the impact of business reporting, information visualization and dashboards.
3. Understand and apply Model-Based Decision Making and Knowledge Management
4. Understand and apply the Fundamentals of Big Data Analytics.
5. Understand the Impacts of Analytics in Organizations

COURSE CONTENT

Business Analytics and Intelligence		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

An Overview of Business Intelligence, Analytics, and Decision Support: Managerial Decision Making, Information Systems Support for Decision Making, An Early Framework for Computerized Decision Support, The Concept of Decision Support Systems (DSS), A Framework for Business Intelligence (BI), Business Analytics Overview, Brief Introduction to Big Data Analytics.

Foundations and Technologies for Decision Making: Decision Making: Introduction and Definitions, Phases of the Decision-Making Process, Decision Making: The Intelligence Phase, Decision Making: The Design Phase, Decision Making: The Choice Phase, Decision Making: The Implementation Phase, How Decisions Are Supported, Decision Support Systems: Capabilities, DSS Classifications.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12

Business Reporting, Visual Analytics, and Business Performance Management: Business Reporting Definitions and Concepts, Data and Information Visualization, Different Types of Charts and Graphs, The Emergence of Data Visualization and Visual Analytics, Performance Dashboards, Business Performance Management, Performance Measurement, Balanced Scorecards, Six Sigma as a Performance Measurement System.

Unit–III:	No. of Lectures: 09 Hours	Marks: 12

Model-Based Decision Making: Optimization and **Multi-Criteria Systems:** Decision Support Systems Modeling, Structure of Mathematical Models for Decision Support, Certainty, Uncertainty, and Risk, Decision Modeling with Spreadsheets, Mathematical Programming Optimization, Multiple Goals, Sensitivity Analysis, What-If Analysis, and Goal Seeking, Decision Analysis with Decision Tables and Decision Trees, Multi-Criteria Decision Making With Pairwise Comparisons.

Knowledge Management and Collaborative Systems: Introduction to Knowledge Management, Approaches to Knowledge Management, Information Technology (IT) in Knowledge Management, Making Decisions in Groups: Characteristics, Process, Benefits, and Dysfunctions, Supporting Group work with Computerized Systems, Tools for Indirect Support of Decision Making, Direct Computerized Support for Decision Making: From Group Decision Support Systems to Group Support Systems

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Big Data and Analytics: Definition of Big Data, Fundamentals of Big Data Analytics, Big Data Technologies, Data Scientist, Big Data and Data Warehousing, Big Data Vendors, Applications of Stream Analytics.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Business Analytics: Emerging Trends and Future Impacts: Location-Based Analytics for Organizations, Location-Based Analytics for Organizations, Recommendation Engines, Web 2.0 and Online Social Networking, Cloud Computing and BI, Impacts of Analytics in Organizations: An Overview, Issues of Legality, Privacy, and Ethics, An Overview of the Analytics Ecosystem.

Text Books:

1. R. Sharda, D. Delen, & E. Turban, Business Intelligence and Analytics. Systems for Decision Support,10th Edition. Pearson/Prentice Hall, 2015.

Reference Books:

1. Business Process Automation, Sanjay Mohapatra, PHI.
2. Introduction to business Intelligence and data warehousing, IBM, PHI.

Data Analytics (Professional Elective Course – VI)					
COURSE OUTLINE					
Course Title:	**Data Analytics**	**Short Title:**	**DA**	**Course Code:**	
Course description:					
Data Analysis is an ever-evolving discipline with lots of focus on new predictive modeling techniques coupled with rich analytical tools that keep increasing our capacity to handle big data.					
Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	3	**15**	**42**	**3**	
Prerequisite course(s):					
Data Mining					
Course objectives:					
1. To understand the concepts of big data 2. To understand the concepts of Data science 3. To do the data analysis 4. To apply the concepts of data visualization 5. To apply data analytics tools					
Course outcomes:					
After successful completion of this course the student will be able to:					
1. Understand the concepts of big data 2. Understand the concepts of Data science 3. Do the data analysis 4. Apply the concepts of data visualization 5. Apply data analytics tools					
COURSE CONTENT					
Data Analytics			**Semester:**	**VIII**	
Teaching Scheme:			**Examination Scheme:**		
Lectures:	**3 hours/week**		**End Semester Exam (ESE):**	**60 marks**	
			Duration of ESE:	**03 hours**	
			Internal Sessional Exam (ISE):	**40 marks**	
Unit–I:	**No. of Lectures: 09 Hours**		**Marks: 12**		
Introduction to Big Data: Big data, 3V's, 4 V's of big data, Types of Big data, Analytics, Industry examples of Big data, Data risk, Big data technologies, Big data architecture, operational and analytical big data technologies, big data and eGovernance, Benefits of Big data, analytics and cloud computing, Crowd sourcing analytics.					
Unit–II:	**No. of Lectures: 09 Hours**		**Marks: 12**		
Introduction to Data Science: Data Science, Terminology Related with Data Science, Methods of Data Repository, Personnel Involved with Data Science, Types of Data, The Data Science Process (DSP), Popular Data Science Toolkits, Familiarity with Example Applications					

Unit–III:	No. of Lectures: 08 Hours	Marks: 12
Data Analysis: Introduction to Applied Statistical Techniques, Types of Statistical Data, Types Of Big Data Analytics, Collecting Data for Sampling and Distribution, Probability, Frequency Distribution, Population and Parameters, Central Tendency or Central Value, Measures Of Central Tendency, Different Types of Statistical Means, Problems of Estimation : Population or Sample, Normal Distribution Curve		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Data Visualization: Data Visualization, Importance of Data Visualization, Conventional Data Visualization Methods, Retinal Variables, Mapping Variables to Encodings, Case Study, Recent trends in various data collection and analysis techniques, Various Big Data Visualization Tools, Visualizing Big Data, Preattentive Attributes, Challenges of Big Data Visualization, Potential Solutions, Future Progress of Big Data Visualization		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Advanced Analytics: Technology and Tools: Hadoop: Architecture, components of Hadoop framework, Analysing big data with Hadoop. MapReduce: Overview, Map Operations, HIVE: features, architecture, working, data models. PIG: Introduction, components, pig vs MapReduce, Pig vs HIVE,		

Text Books:

1. V.K.Jain, "Data Science and Analytics", Khanna Book Publishing Co.(P) LTD. Edition 2018
2. V.K.Jain, "Big Data and Hadoop", Khanna Book Publishing Co.(P) LTD. Edition 2017

Reference Books:

1. Maheshwari Anil, Rakshit, Acharya, "Data Analytics", McGraw Hill, ISBN: 789353160258.
2. Mark Gardner, "Beginning R: The Statistical Programming Language", Wrox Publication,ISBN: 978-1-118-16430-3
3. David Dietrich, Barry Hiller, "Data Science and Big Data Analytics", EMC education services, Wiley publications, 2012, ISBN0-07-120413-X
4. Ashutosh Nandeshwar , "Tableau Data Visualization Codebook", Packt Publishing, ISBN 978-1-84968-978-6
5. Luís Torgo, "Data Mining with R, Learning with Case Studies", CRC Press, Talay and Francis Group, ISBN9781482234893
6. Carlo Vercellis, "Business Intelligence - Data Mining and Optimization for Decision Making", Wiley Publications, ISBN: 9780470753866.

Blockchain (Professional Elective Course – VI)

COURSE OUTLINE

Course Title:	**Blockchain**	**Short Title:**	**BC**	**Course Code:**	

Course description:

The aim of this course is to introduce the fundamental concepts of Blockchain. Blockchain is an emerging technology platform for developing decentralized applications and data storage, over and beyond its role as the technology underlying the cryptocurrencies. The basic tenet of this platform is that it allows one to create a distributed and replicated ledger of events, transactions, and data generated through various IT processes with strong cryptographic guarantees of tamper resistance, immutability, and verifiability. It has applications in finance, government, media and almost all other industries.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**14**	**42**	**3**

Prerequisite course(s):

Data Structures and Algorithms

Course objectives:

1. To provide conceptual understanding of how blockchain technology can be used to innovate and improve business processes.
2. To cover the technological underpinning of blockchain operations in both theoretical and practical implementation of solutions using blockchain technology.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the structure of a blockchain and why/when it is better than a simple distributed database
2. Discuss security aspects in blockchain through cryptography.
3. Describe how Cryptocurrency mining works.
4. Write smart contract using Ethereum frameworks and Hyperledger Fabric .
5. Integrate ideas from various domains and develop block chain based solutions.

COURSE CONTENT

Blockchain		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction:
Distributed systems: CAP Theorem, Byzantine General Problem, Consensus, History of Blockchain, Introduction to Blockchain, Generic Elements of blockchain, Features of blockchain, Applications of Blockchain, Tiers of blockchain, Types of blockchain, Consensus in blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

Cryptography in Blockchain:
Cryptographic primitives, Symmetric cryptography: Stream cipher, Block Ciphers, Data Encryption standard, Advanced Encryption Standard, Asymmetric cryptography, Public and private keys: RSA, Discrete Logarithm problem, Hash functions, Secure Hash Algorithms, Merkle Trees, Patricia Trees, Distributed Hash Table, Digital Signatures

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Understanding Block chain with Crypto currency:
Bitcoin definition, Transactions: life cycle, structure and types of transaction, Blockchain: structure of a block, structure of a block header, The genesis block: Mining , Task of miners, synching up with the network, Proof of Work, Mining Algorithms, Hashing rate, Mining Systems, Mining Pools, Bitcoin Network, Bitcoin Limitations

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Smart Contracts and Ethereum:
Smart Conracts: History, Definition, Ricardian contracts: Smart contract templates, Smart Oracles, Deploying smart contract on Blockchain
Ethereum: Introduction, Ethereum blockchain, Elements of Ethereum blockchain, Precompiled contracts, Accounts, Block, Genesis Block, Transaction validation and execution, The block validation mechanism: block finalization, Ether, Messages, Mining, Mining Rings, Mining Pools

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Hyperledger and Block chain outside of Currencies:
Hyperledger Fabric : Architecture , Membership, Blockchain services: consensus manager, distributed ledger, peer to peer protocol, Ledger Storage, Components of Fabric: Peers, Applications on Blockchain,
Blockchain outside of Currencies: Internet of Things, Government, Health, Finance, Media

Text Books:

1. Imran Bashir, “Mastering Block Chain: Deeper insights into decentralization, cryptography, Bitcoin and popular Blockchain frameworks”, Packt Publishing

Reference Books:

1. Melanie Swan, “Blockchain: Blueprint for a New Economy”, O’Reilly, 2015
2. Josh Thompsons, “Blockchain: The Block Chain for Beginners- Guide to Block chain Technology and Leveraging Block Chain Programming”
3. Daniel Drescher, “Blockchain Basics”, Apress; 1 st edition, 2017
4. Anshul Kaushik, “Blockchain and Crypto Currencies”, Khanna Publishing House, Delhi.
5. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, Packt Publishing
6. Ritesh Modi, “Solidity Programming Essentials: A Beginner’s Guide to Build Smart Contracts for Ethereum and Block Chain”, Packt Publishing
7. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O’Dowd, Venkatraman Ramakrishna, “Hands-On Blockchain with Hyperledger: Building Decentralized Applications with Hyperledger Fabric and Composer”, Import, 2018

Quantum Computing (Professional Elective Course – VI)					
COURSE OUTLINE					
Course Title:	**Quantum Computing**	**Short Title:**	**QC**	**Course Code:**	
Course description:					
Quantum computing is the introductory course. The basic concepts like quantum computing basics , quantum bits, quantum computation, quantum information theory, Correlation between computer science and quantum computing, information theory, and cryptography are covered.					
Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	3	**14**	**42**	**3**	
Prerequisite course(s):					
Basic knowledge of Mathematics					
Course objectives:					
1. To understand basic concepts of quantum computing 2. To learn quantum search algorithms 3. To apply quantum information for solving real world problem					
Course outcomes:					
After successful completion of this course the student will be able to:					
1. To understand the basic concepts of quantum computing. 2. To understand quantum algorithms 3. To understand the concept of quantum communication 4. To understand the security of information in quantum computing. 5. To know the basic requirements for implementation of quantum computers.					
COURSE CONTENT					
Quantum Computing			**Semester:**	**VIII**	
Teaching Scheme:			**Examination Scheme:**		
Lectures:	**3 hours/week**		**End Semester Exam (ESE):**	**60 marks**	
			Duration of ESE:	**03 hours**	
			Internal Sessional Exams (ISE):	**40 marks**	
Unit–I:	**No. of Lectures: 08 Hours**		**Marks: 12**		
Fundamental concepts Introduction and overview, Global perspectives, Quantum bits, Quantum computation, Quantum algorithms, Experimental quantum information processing, Quantum information, Quantum information in a wider context.					
Unit–II:	**No. of Lectures: 08 Hours**		**Marks: 12**		
Introduction to Quantum Mechanics Linear algebra, The postulates of quantum mechanics, Application: super dense coding The density operator, The Schmidt decomposition and purifications, EPR and the Bell inequality					

Unit–III:	No. of Lectures: 10 Hours	Marks: 12
Introduction to computer science Models for computation, The analysis of computational problems, Perspectives on computer science **Quantum computation** Quantum circuits, Quantum algorithms, Single qubit operations, Controlled operations Measurement, Universal quantum gates, Summary of the quantum circuit model of computation, Simulation of quantum systems.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Quantum computers: physical realization Guiding principles, Conditions for quantum computation, Harmonic oscillator quantum computer, Optical photon quantum computer, Optical cavity quantum electrodynamics Iontraps, Nuclear Magnetic Resonance, Other implementation schemes		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Quantum information theory Distinguishing quantum states and the accessible information, Data compression, Classical information over noisy quantum channels, Quantum information over noisy quantum channels Entanglement as a physical resource, Quantum cryptography		
Text Books:		
1. Michael A. Nielsen and Isaac L. Chuang, "Quantum Computation and Quantum Information" , Cambridge University Press		
Reference Books:		
1. Mikio Nakahara and Tetsuo Ohmi, "Quantum Computing", CRC Press 2008. 2. N. David Mermin, "Quantum Computer Science", Cambridge 2007		

Information Retrieval (Professional Elective Course – VI)					
COURSE OUTLINE					
Course Title:	**Information Retrieval**	**Short Title:**	**IR**	**Course Code:**	
Course description:					
This course provides basics of information retrieval and in particular the heart of search engines, processing of Boolean queries, augmentation of inverted index for functionality and speed, search structures for dictionaries, algorithms for constructing the inverted index, techniques for compressing dictionaries, and evaluation of an information retrieval system based on the relevance of documents.					
Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	3	**14**	**42**	**3**	
Prerequisite course(s):					
Data structures and algorithms					
Course objectives:					
Enable students to understand the various aspects of an information retrieval system and its evaluation and to be able to design such systems from scratch.					
Course outcomes:					
After successful completion of this course the student will be able to:					
1. Process Boolean queries using inverted indexes 2. Process queries in the document collection being searched 3. Understand techniques for compressing dictionaries 4. Evaluate Information retrieval systems 5. Use enhanced retrieval techniques					
COURSE CONTENT					
Information Retrieval			**Semester:**	**VIII**	
Teaching Scheme:			**Examination Scheme:**		
Lectures:	**3 hours/week**		**End Semester Exam (ESE):**	**60 marks**	
			Duration of ESE:	**03 hours**	
			Internal Sessional Exam (ISE):	**40 marks**	
Unit–I:	**No. of Lectures: 08 Hours**		**Marks: 12**		
Boolean retrieval: An example information retrieval problem, A first take at building an inverted index, Processing Boolean queries, The extended Boolean model versus ranked retrieval, **The term vocabulary and postings lists:** Document delineation and character sequence decoding, Determining the vocabulary of terms: Tokenization, Dropping common terms: stop words, Normalization (equivalence classing of terms), Stemming and lemmatization, Faster postings list intersection via skip pointers, Positional postings and phrase queries					

Unit–II:	No. of Lectures: 08 Hours	Marks: 12
Dictionaries and tolerant retrieval: Search structures for dictionaries, Wildcard queries, Spelling correction: Implementing spelling correction, Forms of spelling correction, Edit distance, k-gram indexes for spelling correction, Context sensitive spelling correction, Phonetic correction **Index construction:** Hardware basics, Blocked sort-based indexing, Single-pass in-memory indexing, Distributed indexing, Dynamic indexing, Other types of indexes		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Index compression: Statistical properties of terms in information retrieval, Dictionary compression, Dictionary as a string, Blocked storage, Postings file compression, Variable byte codes, Gamma codes **Scoring, term weighting and the vector space model:** Parametric and zone indexes, Term frequency and weighting, The vector space model for scoring, Variant tf-idf functions		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Computing scores in a complete search system: Efficient scoring and ranking, Components of an information retrieval system, Tiered indexes, Query-term proximity, Designing parsing and scoring functions, Putting it all together, Vector space scoring and query operator interaction, **Evaluation in information retrieval:** Information retrieval system evaluation, Standard test collections, Evaluation of unranked retrieval sets, Evaluation of ranked retrieval results, Assessing relevance, Critiques and justifications of the concept of relevance, A broader perspective: System quality and user utility		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Relevance feedback and query expansion: Relevance feedback and pseudo relevance feedback, The Rocchio algorithm for relevance feedback, Probabilistic relevance feedback, When does relevance feedback work?, Relevance feedback on the web, Evaluation of relevance feedback strategies, Pseudo relevance feedback, Indirect relevance feedback, Global methods for query reformulation, Vocabulary tools for query reformulation, Query expansion, Automatic thesaurus generation **Probabilistic information retrieval:** Review of basic probability theory, The Probability Ranking Principle, The Binary Independence Model, An appraisal of probabilistic models, Tree-structured dependencies between terms, Okapi BM25: a non-binary model, Bayesian network approaches to IR		
Text Books:		
1. C. D. Manning, P. Raghavan, and H. Schutze, An Introduction to Information Retrieval, Cambridge University Press, 2009.		
Reference Books:		
1. R. Baeza-Yates and B. Ribeiro-Neto, Modern Information Retrieval, Pearson Education, 1999.		

Ethical Practices in Business (Open Elective Course – IV)					
COURSE OUTLINE					
Course Title:	**Ethical Practices in Business**	**Short Title:**	**EPB**	**Course Code:**	
Course description:					
This course introduces Business ethics as the modern managerial approach to ethical questions in business environment. It gives not only understanding of main theoretical concepts, but also developing skills of identification, analysis and permission of ethical dilemmas on a workplace and managing ethics in organizations.					
Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	3	**14**	**42**	**3**	
Prerequisite course(s):					
Course objectives:					
1. To know the Business Ethics. 2. To understand ethical decision making in Business. 3. To gain knowledge about Corporate Ethics. 4. To know the Corporate Social Responsibility. 5. To understand the Environmental Ethics.					
Course outcomes:					
After successful completion of this course the student will be able to:					
1. Explain need for business ethics. 2. Apply the concept of decision making in Business. 3. Analyze different issues in Corporate Governance, strategies and techniques. 4. Describe Corporate Social Responsibility. 5. Solve issues related to environmental ethics.					
COURSE CONTENT					
Ethical Practices in Business			**Semester:**	**VIII**	
Teaching Scheme:			**Examination Scheme:**		
Lectures:	**3 hours/week**		**End Semester Exam (ESE):**	**60 marks**	
			Duration of ESE:	**03 hours**	
			Internal Sessional Exam (ISE):	**40 marks**	
Unit–I:	**No. of Lectures: 09 Hours**		**Marks: 12**		
Introduction to Business Ethics: Introduction, Principles of Personal Ethics, Principles of Professional Ethics, Business Ethics, Code of Conduct and Ethics for Managers, Importance and Need for Business Ethics, Characteristics of An Ethical Organization, Ethical Theories in Relation to Business, Principles of Justice. Ethical Dilemmas: Introduction, Sources of Ethical Problems, How to Resolve an Ethical Problem, How to Resolve an Ethical Dilemmas.					
Unit–II:	**No. of Lectures: 09 Hours**		**Marks: 12**		

Business Ethics: Introduction, Ethical Decision Making in Business with Cross-Holder Conflicts and Competition, Applying Moral Philosophy to Ethical Decision Making, Ethical Decision Making in Business, Cognitive Moral Development, Kohlberg's Model of Cognitive Moral Development, Influences on Ethical Decision Making.
Globalization and Business Ethics: Growth of Global Corporation, Factors Facilitating Globalization, Role of Multinational Corporation, International Business Issues, Benefits of MNC's to the Host Nation, Disadvantages of MNC's to the Host Country, Creating of an Ethical Organization:

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Corporate Ethics: Introduction to Corporate Governance, Significance of Corporate Governance to Developing Countries, Issues in Corporate Governance, Strategies, Techniques, and benefits to Corporate Governance, Indian Model of Corporate Governance, Good Governance, Obligations, Ethical Governance Needed to Protect Stakeholders, Long Term Shareholder value, Right's of Share Holders, Investor Protection in India, Problems of Investor in India.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Corporate Social Responsibility: Introduction to CSR, Models for Implementation of CSR, Advantage and Scope of CSR, Steps to Attain CSR, External Standards on CSR, Prestigious Awards for CSR.
Ethics of Consumer Protection: Consumer-An Important Stakeholder, Stakeholder Alliance, Consumer Protection, Consumer Duties, Consumer Protection In India.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Environmental Ethics: Environmental Concerns, History, Philosophy, Theories of Environmental Ethics, International Issues, Sustainable Development, Cost and Benefits of Environmental Regulation, Industrial Pollution, Role of Corporation In Environmental Management, Waste Management and Pollution Control, Managing Environmental Issues, Environmental Risk Management, Environment Management in India.

Text Books:

1. A. C. Fernando, K. P. Muraleedharan, E. K. Satheesh, "Business Ethics An Indian Perspective", Third Edition, Pearson.

Reference Books:

1. Manuel G. Velasquez, "Business Ethics Concept and Cases", Seventh Edition, Pearson.
2. B. N. Ghosh, "Business Ethics and Corporate Governance", Tata McGraw Hill.
3. John R. Boatright, Jeffrey D. Smith, Bibhu Prasan Patra, "Ethics and The Conduct of Business", Eight Edition, Pearson.

Total Quality Management (Open Elective Course – IV)

COURSEOUTLINE

Course Title:	**Total Quality Management**	**Short Title:**	**TQM**	**Course Code:**	

Course Description:

This course exposes participants to contemporary knowledge and techniques of TQM. This would in turn enable the participant to articulate and implement quality improvement processing the workplace, in line with the philosophy of Total Quality Management.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester Credits**
	3	**14**	**42**	**3**

Pre-requisite Course(s):

Course Objectives:

To give the students an overview of quality and TQM and explaining the salient contributions of Quality Gurus like Deming, Juran and Crosby. General barriers in implementing TQM.

Course Outcomes:

After successfully completion of this course students will be able to:

1. Implement the principles and concepts inherent in a Total Quality Management (TQM) approach to managing a manufacturing or service organization.
2. Understand the philosophies--including similarities and differences--of the gurus of TQM in order to better evaluate TQM implementation proposals offered by quality management organiza-tions and consultants.
3. Utilize Statistical Process Control (SPC) techniques as a means to diagnose, reduce and eliminate causes of variation.
4. Apply various quality improvement techniques.
5. Successfully implement process improvement teams trained to use the various quality tools for identifying appropriate process improvements & assess exactly where an organization stands on quality management with respect to the ISO 9000 quality management standard.

COURSE CONTENT

Total Quality Management		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**

	Internal Sessional Exams (ISE):	**40 marks**
Unit – I:	**No. of Lectures: 09 hours**	**Marks: 12**
Introduction to Quality Management: Definitions – TOM framework, benefits, awareness and obstacles. Quality – vision, mission and policy statements. Customer Focus – customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality.		
Unit – II:	**No. of Lectures: 08 hours**	**Marks: 12**
Principles & Philosophies of Quality Management: Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi techniques – introduction, loss function, parameter and tolerance design, signal to noise ratio. Concepts of Quality circle, Japanese 5S principles and 8D methodology.		
Unit – III:	**No. of Lectures: 09 hours**	**Marks: 12**
Statistical Process Control & Process Capability: Meaning and significance of statistical process control (SPC) – construction of control charts for variables and attributed. Process capability – meaning, significance and measurement – Six sigma concepts of process capability. Reliability concepts – definitions, reliability in series and parallel, product life characteristics curve. Total productive maintenance (TMP) – relevance to TQM, Terotechnology. Business process re-engineering (BPR) – principles, applications, reengineering process, benefits and limitations.		
Unit – IV:	**No. of Lectures: 08 hours**	**Marks: 12**
Tools & Techniques for Quality Management: Quality functions development (QFD) – Benefits, Voice of customer, information organization, House of quality (HOQ), building a HOQ, QFD process. Failure mode effect analysis (FMEA) – requirements of reliability, failure rate, FMEA stages, design, process and documentation. Seven old (statistical) tools. Seven new management tools. Bench marking and POKA YOKE.		
Unit – V:	**No. of Lectures: 08 hours**	**Marks: 12**
Quality Systems organizing & Implementation: Introduction to IS/ISO 9004:2000 – quality management systems – guidelines for performance improvements. Quality Audits. TQM culture, Leadership – quality council, employee involvement, motivation, empowerment, recognition and reward- Introduction to software quality.		
Text Books:		
1.Janakiraman. B and Gopal.R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006. 2. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt.		

Ltd., 2006.
3. RamasamySubburaj, "Total Quality Management", Mc Graw Hill, New Delhi.

Reference Books:

1. Dale H.Besterfield et al, Total Quality Management, Third edition, Pearson Education, (First Indian Reprints 2004).
2. Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, First Edition 2002.
3. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
4. ISO 9001-2015 standards

Logical Reasoning and Problem Solving (Open Elective Course – IV)					
COURSE OUTLINE					
Course Title:	**Logical Reasoning and Problem Solving**	**Short Title:**	**LRPS**	**Course Code:**	
Course description:					
This course enables students to develop their ability to reason by introducing them to elements of formal reasoning. The primary focus will be on recognizing the logical structure of arguments. Topics will include types of statements, symbolism, logical connectives, logical relations, basic deductive inferences, truth tables, validity, invalidity, and soundness; and may include, in addition, inductive reasoning.					

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**14**	**42**	**3**

Prerequisite course(s):

Course objectives:

1. Course will provide an introduction to logical and philosophical reasoning.
2. Acquires, analyzes, and evaluates information from multiple sources.
3. Reflects on experiences with diversity to demonstrate knowledge and sensitivity.

Course outcomes:

After successful completion of this course the student will be able to:

1. Tell Analogy, Classification, perform coding and decoding on data
2. Recognize logical and philosophical reasoning.
3. Recognize logical reasoning applicable to real-life situations, solve real-life problems
4. Experience with diversity to demonstrate knowledge and sensitivity.
5. Solve application problems involving Clock, Calendar and Ratio and Proportion.

COURSE CONTENT

Logical Reasoning and Problem Solving		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Analogy : Completing the analogous pair, Direct/ Simple Analogy, Choosing the analogous pair, Double Analogy Choosing a similar word, Detecting Analogies, Multiple word analogy, Number analogy, Alphabet Analogy

Classification : Choosing the odd word, Choosing the odd pair of word, Choosing the odd numeral, Choosing the odd numeral pair/ group

Coding and Decoding : Letter coding, Direst letter coding, Number/ Symbol Coding, Matrix Coding , Substitution, Deciphering message word codes, Deciphering number and symbol codes for messages.

Blood relations: Deciphering jumbled up descriptions, Relation puzzle, Coded relations		
Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**
Direction sense Test : Directions and Cardinal Directions , Direction puzzle **Logical Sequence of words :** Sequence in process , Sequence in object formation **Data Sufficiency** : Yes/No Questions, Value Questions **Verification of Truth of the Statement:** Relationship with the thing mentioned.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Logic : Logical Reasoning, Logical Deduction , Two- Premise Arguments, Three- Premise Arguments **Statement – Arguments :** Strong arguments and weak Arguments **Statement –assumption :** Type 1- implicit statement, Type2-Implicit in Context **Statement –Conclusions :** Direct / indirect implications of conclusions		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Mirror-Images : Mirror-Images of Capital letters, Small letters, Numbers and figures **Water-Images :** Water-Images of Capital letters, Small letters, Numbers and figures **Cubes and Dice :** 2D and 3D cubes, Number opened dice and Letter opened dice		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Clocks : Finding Angle Between Minute And Hour Hands, Finding Time If Angle Is Given, Correct Time On Incorrect (Fast or Slow) Clocks. **Calendar:** Odd day, Leap year, Ordinary Year, Counting of Odd days, Day of the week related to odd days. **Ratio and Proportion :** Combined Ratio Based On Individual Ratios, Distributing Any Quantity Based On Ratios, Coins Based Ratio Problems, Mixtures & Replacement Based Ratio Problems **Alligation and mixture**: Allegation, mean price, Rule of Allegation		
Text Books:		
1. Dr. R.S. Aggarwal "A Modern Approach to Verbal & Non-Verbal Reasoning" S. Chand Publication 2. Dr. R.S. Aggarwal "Quantitative Aptitude" S. Chand Publication, Revised Edition 2017		

Robotics (Open Elective Course – IV)					
COURSE OUTLINE					
Course Title:	**Robotics**	**Short Title:**	**RO**	**Course Code:**	
Course description:					
In this course, students take on the roles of mechanical engineers, computer scientists and electrical engineers. Students research dynamics, kinematics and sensors. Topics such as such as motion planning and obstacle avoidance, velocity and acceleration, serial chain mechanisms, pneumatic actuators, and drive circuits are covered.					
Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	3	**14**	**42**	**3**	
Prerequisite course(s):					
Course objectives:					
1. To understand structures and classifications in robotics 2. To gain knowledge of types of actuators and sensors in robotics. 3. To understand and learn robotic transformations. 4. To know different analysis techniques for robotic kinematics and dynamics. 5. To learn control techniques for robotic programming.					
Course outcomes:					
After successful completion of this course the student will be able to:					
1. Explain structure and classification of robots. 2. Define role of actuators, sensors and vision system in robotics 3. Describe various transformations in robots. 4. Analyze the different kinematics and dynamics in robots. 5. Apply control techniques for programming in robotics					
COURSE CONTENT					
Robotics		**Semester:**	**VIII**		
Teaching Scheme:		**Examination Scheme**			
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**		
		Duration of ESE:	**03 hours**		
		Internal Sessional Exam (ISE):	**40 marks**		
Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**			
Introduction to Robotics: Robots, History of Robots, Robots Usage, Basic Structure of Robots, Classification of Robots by Applications, classification by Coordinate Systems, Classification by Actuation System, Classification by Control System, Robot classification by programming method.					
Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**			

Robot Actuators, Sensors and Vision:
Robot Actuators: Pneumatic , Hydraulic and Electric
Robot Sensors: Sensor classification, Internal Sensors, External Sensors, Sensor selection
Vision System in Robots.

Unit–III:	No. of Lectures: 09 Hours	Marks: 12

Transformations and Statics in Robotics:
Robot Architecture, Pose of Rigid Body, Coordinate Transformation, Denavit and Hartenberg(DH) Parameters
Forces and Moment balance, Recursive Calculations, Equivalent Joint Torque, Role of Jocobian in Statics.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Kinematics and Dynamics
Forward Position Analysis, Inverse Position Analysis, Velocity Analysis, Inerita Properties, Eular- Lagrange Formulation, Newton – Eular Formulation, Recursive Newton – Eular Algorithm

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Robotic Control and Programming:
Control Techniques, Second Order Linear Systems, Feedback Control and its Performance, Non Linear Trajectory Control, State Space Representation and Control, Stability, Cartesian and Force Controls, Robotic Programming

Text Books:

1. Saha, S.K., "Introduction to Robotics, 2nd Edition, McGraw-Hill Higher Education, New Delhi, 2014.

Reference Books:

1. Niku Saeed B., "Introduction to Robotics: Analysis, Systems, Applications", PHI, New Delhi.
2. Mittal R.K. and Nagrath I.J., "Robotics and Control", Tata McGraw Hill.
3. Mukherjee S., "Robotics and Automation", Khanna Publishing House, Delhi.
4. Craig, J.J., "Introduction to Robotics: Mechanics and Control", Pearson, New Delhi, 2009.
5. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, "Robot Modelling and Control", John Wiley and Sons Inc, 2005.
6. Steve Heath, "Embedded System Design", 2nd Edition, Newnes, Burlington, 2003.

Cyber Security Lab					
LAB COURSE OUTLINE					
Course Title:	**Cyber Security Lab**	**Short Title:**	**CSL**	**Course Code:**	
Course description:					
Cyber Security Lab course focuses on cyber threats and cyber security that provides the much needed awareness in the times of growing cybercrime episodes.					
Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	2	**14**	**28**	**1**	
End Semester Exam (ESE) Pattern:		**Oral (OR)**			
Prerequisite course(s):					
Computer Network					
Course objectives:					
1. To learn Information Technology Act of India. 2. To understand the importance of Cyber Security. 3. To learn Offensive Cyber Security Tools. 4. To learn Defensive Cyber Security Tools. 5. To learn Security Testing Tools for Web Applications.					
Course outcomes:					
Upon successful completion of lab Course, student will be able to:					
1. To describe Information Technology Act of India. 2. Describe Cyber Security. 3. Demonstrate Offensive Cyber Security Tools. 4. Demonstrate Defensive Cyber Security Tools. 5. Demonstrate Security Testing Tools for Web Applications.					
LAB COURSE CONTENT					
Cyber Security Lab		**Semester:**	**VIII**		
Teaching Scheme:		**Examination scheme:**			
Practical:	**2 hours/week**	**End Semester Exam (ESE): OR**		**25 marks**	
		Internal Continuous Assessment (ICA):		**25 marks**	
1. Study of Information Technology Act – Indian Perspective. 2. Study of recent Cyber Incidents / Vulnerability. 3. Concerned faculty member should suitably frame Four Laboratory assignments with hands-on based on following tools but not limited to: • Security Testing Tools for Web Applications o Tools to Scan Website Security Vulnerabilities & Malware o Security tools for online protection o Check if your password is strong					

- Social Media Security
- Safe Browsing
- Backup
- Reporting to government organizations or cyber security companies

- Networking & Security Auditing Tools
  - Offensive Cyber Security Tools
  - Breach Discovery
  - Internet Security
  - Email Security
  - Cyber Security Frameworks & Operating Systems
  - Vulnerability Scanning Tools
  - Password Management, Recovery & Attack Tools
- Defensive Cyber Security Tools
  - Open source firewall
  - Security Information and Event Management (SIEM) solution
  - Open Source Intelligence (OSINT) Tools
- Open Web Application Security Project (OWASP)

Note: - Use of Open Source Software/Tool/Technology is recommended for laboratory assignments of the concern subject.

Text Books:

References:

1. Awesome Security, https://github.com/sbilly/awesome-security
2. Open Web Application Security Project (OWASP), https://owasp.org/
3. Indian Computer Emergency Response Team, https://www.cert-in.org.in/
4. Kali Linux Tools Listing, https://tools.kali.org/tools-listing
5. National Cyber Crime Reporting Portal, https://cybercrime.gov.in/

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignments.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal.

In the ESE (OR), the students may be asked oral questions to judge depth of understanding.

Advanced Technology Lab - II					
LAB COURSE OUTLINE					
Course Title:	**Advanced Technology Lab - II**	**Short Title:**	**ATL - II**	**Course Code:**	
Course description:					
The course focuses on practical hands-on of recent technologies.					

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	**2**	**14**	**28**	**3**
Laboratory	**2**	**14**	**28**	

End Semester Exam (ESE) Pattern:	**Practical (PR)**

Prerequisite course(s):

Programming Language
Database Management Systems
Computer Network

Course objectives:

To enhance competency by undertaking laboratory assignments using Full Stack.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Break down real world problems / application.
2. Demonstrate Full Stack development.
3. Design Full Stack based applications.
4. Decide tools for Full Stack development.
5. Develop Full Stack based applications.

LAB COURSE CONTENT

Advanced Technology Lab - II		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme:**	
Theory:	**2 hours/week**	**End Semester Exam (ESE): (PR)**	**25 marks**
Practical:	**2 hours/week**	**Internal Continuous Assessment (ICA):**	**25 marks**

Concerned faculty member should suitably frame Three Laboratory assignments using Full Stack (Front End, Back End and Database) by considering the technological aspects, utility and recent trends. The assignments should be based on real world problems / application, other than performed in Advanced Technology Lab - I. The assignments and / or tools in the Full Stack may be framed per individual student or group of students. The assignments may also be based on professional elective course opted by individual student or group of students in the current semester, but must be based on real world problems / application. For better understanding of various facets of different Full Stacks, it is expected that the assignments should be implemented using more than one Full Stacks.

Following are the suggested list of tools but not limited to:

Operating System

- 64-bit Open source Linux or its derivative or Windows

Programming Languages: C++ / C# / JAVA / PYTHON / R

Programming tools:

- Front End: Java / Perl / PHP / Python / Ruby / .NET / HTML / Wordpress / Drupal / Javascript / JQuery / Laravel Blade / MeteorJS / AngularJS / ReactJS / VueJS etc.
- Backend: C / C++ / Java / Java Spring / Java Swing / Node JS / Ruby / Python / .NET / PHP/ Laravel etc.
- Database: MongoDB / MYSQL / Oracle / SQL Server, Database Connectivity: ODBC / JDBC etc.

Some of the Full Stack:

- LAMP / WAMP stack: JavaScript - Linux - Apache - MySQL - PHP
- LEMP / WEMP stack: JavaScript - Linux - Nginx - MySQL - PHP
- MEAN stack: JavaScript - MongoDB - Express - AngularJS - Node.js
- Django stack: JavaScript - Python - Django - MySQL
- Ruby on Rails: JavaScript - Ruby - SQLite - Rails

For each laboratory assignment, Software Engineering approach with proper documentation is required.

Note: - Use of Open Source Software/Tool/Technology is recommended for laboratory assignments of the concern subject.

Text Books:

Reference Books:

Online web Resources

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignments.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification.

Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.

Project					
LAB COURSE OUTLINE					
Course Title:	**Project**	**Short Title:**	**PROJ**	**Course Code:**	
Course description:					
Project represents the culmination of study towards the Bachelor of Engineering degree. The project offers the opportunity to apply and extend material learned throughout the program. The emphasis is necessarily on facilitating student learning in technical, project management and presentation spheres.					
Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	6	**14**	**84**	**3**	
End Semester Exam (ESE) Pattern:		**Oral (OR)**			
Prerequisite course(s):					
Course objectives:					
1. To understand the basic concepts & broad principles of projects. 2. To understand the value of achieving perfection in project implementation & completion. 3. To apply the theoretical concepts to solve problems with teamwork and multidisciplinary approach. 4. To demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context.					
Course outcomes:					
Upon successful completion of lab Course, student will be able to:					
1. Demonstrate a sound technical knowledge of their selected project topic. 2. Undertake problem identification, formulation and solution. 3. Design engineering solutions to complex problems utilizing a systems approach. 4. Conduct an engineering project 5. Demonstrate the knowledge, skills and attitudes of a professional engineer.					
LAB COURSE CONTENT					
Project		**Semester:**	**VIII**		
Teaching Scheme:		**Examination scheme:**			
Practical:	**6 hours/week**	**End semester exam (ESE): (OR)**	**50 marks**		
		Internal Continuous Assessment (ICA):	**50 marks**		
In continuation with Project (Stage – I) at Semester – VII, by the end of Semester – VIII, the students should complete implementation of ideas as formulated in Project (Stage – I). It may involve fabrication / coding, experimentation, data analysis within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability. It may also include testing, results and report writing. Each student group should submit complete project report at the end of Semester-VIII in the form of Hard bound. Assessment for					

the project shall also include presentation by the students.

Each student group is required to maintain separate log book for documenting various activities of the project.

Suggestive outline for the complete project report is as follows.

Abstract

Chapter 1. Introduction

- Background
- Motivation
- Problem Definition
- Scope
- Objective
- Selection of Life cycle Model for Development
- Organization of Report
- Summary

Chapter 2. Project Planning and Management

- Feasibility Study
- Risk Analysis
- Project Scheduling
- Effort Allocation
- Cost Estimation
- Summary

Chapter 3. Analysis

- Requirement Collection and Identification
- H/w and S/w Requirement (Data, Functional and Behavioral)
- Functional and non-Functional Requirements
- Software Requirement's Specification (SRS)
- Summary

Chapter 4. Design

- System Arch
- Data Flow Diagram
- UML Diagrams (Use case, Class, Sequence, Component, Deployment, State chart, Activity diagram etc.)
- Summary

Chapter 5. Coding/Implementation

- Algorithm/Steps
- Software and Hardware for development in detail
- Modules in Project

Chapter 6. Testing

- Black Box/White Box testing
- Manual/Automated Testing
- Test Cases Identification and Execution (Test case ID, Input, Output, Expected Output, Actual Output, Result (Pass/Fail) etc.)

Chapter 7. Results and Discussion

Chapter 8. Conclusion & Future Work

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Appendix

Guide lines for ICA:

The Internal Continuous Assessment (ICA) for project shall be based on continuous evaluation of students' performance, active participation, knowledge / skill acquired throughout semester and presentation by the students. The assessment shall be done jointly by the guide and departmental committee. A three-member departmental committee including guide, appointed by Head of the department, shall be constituted for the assessment. The assessment for Project in Semester – VIII shall be as per the guidelines given in Table – B.

Table – B

		Assessment by Guide				Assessment by Departmental Committee			
Sr. No.	Name of the Student	Attendance / Participation	Implementation	Results	Report	Depth of Understanding	Presentation	Demonstration	Total
	Marks	5	5	5	5	10	10	10	50

Guidelines for ESE:

In End Semester Examination (ESE), the student may be asked for presentation / demonstration and questions on Project. Evaluation will be based on answers given by students in oral examination.