Walchand College of Engineering, Sangli

(A Govt. Aided Autonomous Institute)

1947

Credit System and Course Content
Final Year B.Tech.
(Computer Science and Engineering)
Semester VII and VIII

Academic Year 2020-21

Final Year B. Tech. (CSE) Curriculum for 2020-21

Table of Credits (2020-2021)

Sr. No	Odd Sem Credits	Even Sem Credits	Total Credits
FY	20	19	39
SY	20	20	40
TY	24	19	43
Final Year	24	14	38
Total Credits	88	72	160

Credit System and Evaluation Scheme

Walchand College of Engineering, Sangli.

(An Autonomous Institute)

Teaching and Evaluation Scheme for Year 2020-21

Final Year UG Program in Computer Science & Engineering

Semester I

Sr.No.	AICTE Category	Course Code	Course Name	L	T	P	Hrs	Credits	ISE-1	MSE*	ISE-2	ESE
Professional Core (Theory)												
1	PC	3CS401	Information Security	3	0	0	3	3	10	30	10	50
2	PC	3CS402	Data warehousing & Data Mining	3	0	0	3	3	10	30	10	50
Professional Core (Lab)												
3	PC	3CS451	Information Security Lab	0	0	2	2	1	25	25	25	25
4	PC	3CS452	Data warehousing & Data Mining Lab	0	0	2	2	1	25	25	25	25
5	PC	3CS491	Project - I	0	0	4	4	2	25	25	25	25
Institute Core												
6	HS	3IC401	Engineering management and ethics	4	0	0	4	4	10	30	10	50
Professional Elective												
7	PE	3CS4**	Professional Elective V	3	1	0	4	4	10	30	10	50
8	PE	3CS4**	Professional Elective VI	3	0	0	3	3	10	30	10	50
Open Elective												
9	OE	1OE***	Open Elective III	3	0	0	3	3	10	30	10	50
Value Added Professional Courses												
10	VAPC	Refer list	Value Added Professional Courses				2	# 2				
Value Added Life-Skill Courses												
11	VALS	Refer list	Value Added Life Skill Courses				2	# 2				
			Total	**19**	**1**	**8**	**28**	**24**				

Course List for Final Year B.Tech. CSE Sem VII AY 2020-21

Sr.No.	Course Code	Course Name
Professional Elective V		
1	3CS 411	High Performance Computing
2	3CS 412	Machine learning

Sr.No.	Course Code	Course Name
Professional Elective VI		
1	3CS 414	Software Defined Networking
2	3CS 415	Software Design and Architecture
3	3CS 416	RTOS and Embedded Systems

Walchand College of Engineering, Sangli.

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Teaching and Evaluation Scheme for Year 2020-21

Final Year UG Program in Computer Science & Engineering

Semester II

Sr.No.	Category	Course Code	Course Name	L	T	P	Hrs	Credits	ISE-1	MSE*	ISE-2	ESE
Professional Core (Lab)												
1	PC	3CS492	Project -II	0	0	$16	8	10	25	25	25	25
2	PC	3CS493	Techno Socio Outreach	1			1	1	25	25	25	25
Professional Elective												
3	PE	3CS43*	Professional elective VII	3	0	0	3	3	10	30	10	50
Value Added Professional Courses												
4	VAPC	Refer list	Value Added Professional Courses				2	# 2				
Value Added Life-Skill Courses												
5	VALS	Refer list	Value Added Life Skill Courses				2	# 2				
			Total	**4**	**0**	**16**	**12**	**14**				

Course List for Final Year B.Tech. CSE Sem VIII AY 2020-21

Sr.No.	Course Code	Course Name
Professional Elective VII		
1	3CS431	Computer Forensic
2	3CS432	Search Engine Design and Optimization
3	3CS433	Storage Systems

ODD Semester

Professional Core (Theory) Courses

Title of the Course: Information Security **Course Code: 3CS401**	L	T	P	Cr
	3	-	-	3

Pre-Requisite Courses: Data Communication and Computer Network

Textbook:

1. "*Cryptography and Network Security Principles and Practices*", William Stallings 5th Ed. (LPE)
2. "*Cryptography and Network Security*", Atul Kahate, (TMH)

References:

1. "*Network Security", Private Communication in a Public World*", Kaufman, Perlman, Speciner, 2nd Ed. (LPE)
2. "*Applied Cryptography: Protocols & Algorithms*", BruceSchneier, (Wiley)
3. "*Cryptography and Network Security*", Behrouz A. Forouzan (TMH)

Course Objectives :

1. To acquire knowledge in security services, goals and mechanism and understand the mathematical foundation required for Cryptography.
2. To understand the basic concept of Cryptography and Network Security protocols.
3. To provide knowledge on Cryptographic hash functions, key Exchange Algorithms and system security tools.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	describe and explain the fundamental concepts of information security and mathematical foundation required for Cryptography.	1,2	Remembering, understanding
CO2	apply information security and network security concepts to individual computer; network as well as to any web application.	3	Applying
CO3	differentiate and analyze various types of Cryptographic algorithms and Cryptographic hash functions and also demonstrate the knowledge of key exchange techniques.	4	Analyzing

CO-PO Mapping :

	a	**b**	**C**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
CO1	3	2	-	-	2	-	-	-	-	-	-
CO2	-	3	-	2	3	-	-		1	-	-
CO3	-	-	-	2	3	-	-	-	-	-	-

1: Low, 2: Medium, 3: High

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1: Introduction Security Goals, Attacks, Services and Mechanisms, A Model for Network Security, Mathematics of Cryptography: Modular Arithmetic, Euclidian Algorithm, Fermat's and Euler's Theorems, The Chinese Remainder Theorem (CRT), Discrete Logarithms.	**8Hrs.**
Module 2: Symmetric Ciphers Stream Cipher and Block Cipher, Classical Encryption Techniques- Symmetric Cipher Model, Transposition Techniques, Block Ciphers and Data Encryption Standard: The Data Encryption Standard (DES), Advanced Encryption Standard (AES), Block Cipher Operation, Multiple Encryption and Triple DES, Modes of operation.	**7Hrs.**
Module 3: Asymmetric Ciphers Public key Cryptography and RSA, Diffie Hellman key Exchange, ElGamal Cryptosystem, Elliptic Curve Cryptography (ECC).	**6Hrs.**
Module 4: Cryptographic Data Integrity Algorithms Cryptographic hash functions: Applications of cryptographic hash functions, Requirements and security, Secure Hash Algorithm (SHA), Message Authentication Codes, Digital Signatures. Key Management and distribution, Authentication protocols.	**6Hrs.**
Module 5: Network and Internet Security Transport level security: web security issues, Secure Socket Layer (SSL), Transport Layer Security (TLS), SET, HTTPS, Secure Shell (SSH), Electronic mail security: Pretty Good Privacy (PGP), S/MIME, IP Security (IPSec).	**6Hrs.**
Module 6: System Security: Intrusion Detection System (IDS), Malicious softwares, Firewalls.	**6Hrs.**

Module wise Measurable Students Learning Outcomes :
After the completion of the course the student should be able to:
Module 1

1. Able to understand the model of network security, types attacks on system and mathematic foundation required for cryptography.

Module 2

1. Able to understand as well as experiment, types of ciphers like symmetric and asymmetric.
2. Will be able to design simple ciphers and can apply on streams or small block of information,

Module 3

1. Able to differentiate and analyze various types of asymmetric ciphers.

Module 4

1. Able to understand use of hash as well as Mac functions for authentication purpose.
2. Able to build simple authentication techniques by using hash and Mac algorithm.
3. Able to understand the use and design of digital signature in e-documentation.

Module 5

1. Able to understand the IPSec protocol at IP layer.
2. Able to understand software to be used at the application layer for the application security.
3. Able to understand how to make web application secure using protocols like SSL.

Module 6

1. Able to understand the design principles of firewall.
2. Able to understand the process behind working and spreading of malicious software and Also demonstrate the knowledge of intrusion detection systems

Title of the Course: Data Warehousing and Data Mining Course Code: 3CS402	L	T	P	Cr
	3	-	-	3

Pre-Requisite Courses: Database System and some Programming Experience

Textbook:

1. Data Warehousing - Fundamentals for IT Professional: Paulraj Ponniah 2nd Edition. Wiley
2. Data Mining - Introductory and Advanced Topics : Dunham, Margaret H, Prentice Hall.

References:

1. Data Mining - Concepts & Techniques: Jiawei Han &MichelineKamber, Morgan Kaufmann.
2. Building the Data Warehouse- W. H. Inmon, Wiley Dreamtech India Pvt. Ltd...
3. The Data Warehouse Life cycle Tool kit – RALPH KIMBALL WILEY STUDENT EDITION

Course Objectives :

1. To perceive the basic concepts of Data Warehousing, Data mining – its architecture and implementations.
2. To implement and analyze the data warehousing processes and data mining algorithms.
3. To evaluate the different data warehousing and data mining systems/tools.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	describe the data warehousing processes and data mining algorithms.	2,4	Understanding, Analyzing
CO2	evaluate and analyze data warehousing systems and data mining tools.	4, 5	Analyzing, Evaluating
CO3	create the data warehousing systems and implement the different data mining algorithms.	3,6	Applying, Creating

CO-PO Mapping :

	a	b	C	d	e	f	g	h	i	j	k
CO1		2	-	-	-	-	3	-	-	-	-
CO2	-	-	-	-	3	-	-	-	-	-	-
CO3	-	-	-	3	-	-	-	1	-	-	-

1: Low, 2: Medium, 3: High

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1: Data warehousing (DW) Overview and Concepts **The compelling need for data warehousing :**Need for strategic information, failures of past DSS, operational versus DSS, DW-only viable solution. **Data warehouse building blocks** : Defining features, DW and data marts, understanding DW architecture, distinguishing characteristics, architectural framework, Technical architecture, architectural types, metadata in DW.	**5Hrs.**
Module 2: Building the Data Warehouse **Principles of Dimensional Modeling :**From requirements to data design, the star schema, star schema keys, advantages of star schema, star schema examples, snowflake schema. **Data Extraction, Transformation and Loading (ETL) :**ETL overview, ETL requirements and steps, data extraction, data transformation, data loading, ETL summary.	**8 Hrs.**
Module 3: Data Mining **Introduction :** Basic data mining tasks, data mining versus knowledge discovery in databases, data mining issues, data mining metrics, data mining from database perspective, future. **Classification** : Issues in classification, statistical based algorithms, distance based algorithms, neural network based algorithms.	**7Hrs.**
Module 4: Clustering Introduction, similarity and distance measures, outliers, hierarchical algorithms, partition algorithms, clustering large databases.	**7Hrs.**
Module 5: Association rules Introduction, large itemsets, basic algorithms, parallel and distributed algorithm, comparing approaches, measuring the quality of rules.	**6Hrs.**
Module 6: Web Mining Introduction, web content mining, web structure mining, web usage mining	**6Hrs.**

Module wise Measurable Students Learning Outcomes :

After the completion of the course the student should be able to:

Module 1

Understand the need of data warehouse in addition to traditional operational database systems and develop a general framework for decision support within organizations.

Module 2

Understand the concepts, strategies, and methodologies related to the design and build data warehouse and apply their ability to conduct dimensional modeling, data extraction, transformation and loading (ETL) process.

Module 3

Categorize and carefully differentiate between situations for applying different classification algorithms.

Module 4

Describe similarity and distance measures to be apply in clustering algorithms and evaluate the performance of different clustering algorithms

Module 5

Apply different algorithms to generate association rule and evaluate them.

Module 6

Develop the framework for web mining and investigate the model for web structure and usage mining.

ODD Semester

Professional Core (Lab) Courses

Title of the Course: Information Security Lab **Course Code: 3CS451**	L	T	P	Cr
	-	-	2	1

Pre-Requisite Courses: Programming experience C, C++ or Java

Textbook:

1. "*Cryptography and Network Security Principles and Practices*", William Stallings 4th Ed. (LPE)
2. "*Cryptography and Network Security*", Atul Kahate, (TMH)

References:

1. "*Network Security", Private Communication in a Public World*", Kaufman, Perlman, Speciner, 2nd Ed. (LPE)
2. "*Handbook of Applied Cryptography*", Menezes, A. J., P. C. Van Oorschot, and S. A. Vanstone.
3. "*Applied Cryptography: Protocols & Algorithms*", BruceSchneier, (Wiley)

Course Objectives :

1. To study currently available security services, mechanisms and algorithms.
2. To 9practice already implemented algorithms and their revised versions as the countermeasures against the incidental and intentional attacks while handling information in the communication networks
3. To obtain some hands on experience with open source information security tools like Snort, Wireshark and Nessus etc.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	Implement different cryptographic algorithms.	3	Applying
CO2	Demonstrate how to detect and reduce threats in networks.	3	Applying
CO3	Analyze and verify network traffic using different packet sniffing tools	4	Analyzing

CO-PO Mapping :

	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
CO1	3	1	3	-	3	-	-	-	2	-	-
CO2	-	-	3	-	1	-	-	-	3	2	-
CO3	-	-	1	-	-	-	-	-	3	2	-

1: Low, 2: Medium, 3: High

Assessment:

Lab Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.
IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

Week 1 indicates starting week of Semester.
Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

Course Contents:

Laboratory Experiences:

Minimum 8 experiments will be performed to have through understanding and practice of the theory covered in the subject. Some of the topics are listed below:

The lab assignments can be implemented using C / C++ / Java / any other suitable programming language. Few of the *Case Studies* are also suggested which can focus and guideline the security requirements in the practical world.

- Classical Encryption Techniques
- Steganography
- Symmetric Cryptography and DES
- Asymmetric Cryptography and RSA
- Digital Certificate
- Hash Functions, MACs and Digital Signatures
- Key Handling, Exchange and PKI
- Electronic mail and security issues
- IP and Web security issues
- SSL
- Intrusion detection
- Viruses, Threats and countermeasures

The lab work assignments will be periodically assessed by the concerned batch teacher. The performance of individual student in a batch undergoing the lab assignments will be considered in determining term work marks.

Title of the Course: Data Warehousing and Data Mining Lab **Course Code: 3CS452**	L	T	P	Cr
	-	-	2	1

Pre-Requisite Courses: Database System and some Programming Experience

Textbook:

1. Data Warehousing - Fundamentals for IT Professional: PaulrajPonniah 2nd Edition. Wiley
2. Data Mining - Introductory and Advanced Topics: Dunham, Margaret H, Prentice Hall.

References:

1. Data Mining - Concepts & Techniques: Jiawei Han &Micheline Kamber, Morgan Kaufmann.
2. Building the Data Warehouse- W. H. Inmon, Wiley Dreamtech India Pvt. Ltd...
3. The Data Warehouse Life cycle Tool kit – RALPH KIMBALL WILEY STUDENT EDITION
4. Oracle 11g manuals, Open source data warehouse/data miner packages.

Course Objectives :

1. To have the hands-on and practicing the concepts/techniques studied in theory course.
2. To build the data warehouses for real world problems and apply the data mining techniques.
3. To evaluate the different commercial / open source data warehousing and data mining tools.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		Level	Descriptor
CO1	interpret the details of different algorithms made available by popular commercial, open source data mining / data warehousing systems.	1,2	Remembering, Understanding
CO2	compare, evaluate different data warehousing/data mining tools/system.	4,5	Analyzing, Evaluating
CO3	solve the complex problems individually or in groups, develop and demonstrate the data warehousing and data mining systems.	3,6	Applying, Creating

CO-PO Mapping :

	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
CO1	-	-	-	3	-	-	-	-	-	-	-
CO2	-	-	-	-	3	-	-	-	-	-	-
CO3	-	3	1	-	-	-	-	-	-	-	-

1: Low, 2: Medium, 3: High

Assessment:

Lab Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.

IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

Week 1 indicates starting week of Semester.

Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

Course Contents:

Laboratory Experiences:

- It should consist of 8-10 experiments based on syllabus, applied/real world problems in this area.
- 2-4 experiments should be based on case study of commercial, open source data warehousing/ data mining software tools.
- Use the standard data sets from UCI Machine Learning Repository for testing algorithms.
- The student should follow the design, modeling and implementation/documentation methodology using standard CASE tools.
- The detail list of experiments will be display by course teacher by making 60 % variations in each semester.
- Use C#.Net / Python as Programming Language. For database programming / scripting use PL/SQL
- Oracle 11g or IBM DB2 9.7 as backend database server.
- Open source data warehousing/data mining tools.

Title of the Course: Project – I **Course Code: 3CS491**	L	T	P	Cr
	-	-	4	2

Pre-Requisite Courses: Nil

Textbook: Nil

References: Nil

Course Objectives :

1. To understand project identification process and carryout literature survey for real world problem
2. To use latest design, development tools and technologies.
3. To undergo project management techniques.
4. To acquire ability to map technical skills to real life applications through modeling.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	demonstrate the state-of-art technological trends through seminar.	2	Understanding
CO2	work in teams and participate in group activity of software development.	3	Applying
CO3	build and demonstrate the prototype / miniature model.	6	Creating

CO-PO Mapping :

	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
CO1	-	**3**	-	2	-	-	-	-	-	1	-
CO2	-	-	3	-	-	-	-	-	-	-	**1**
CO3	-	-	-	3	-	-	-	-	-	-	-

1: Low, 2: Medium, 3: High

Assessment:

Lab Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.
IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

Week 1 indicates starting week of Semester.
Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

Course Contents:

1. Project work is to be carried out in two semesters with group size of maximum three to four students
2. In first semester project group will select a project topic with consent from guide and approval from department and
3. Students should maintain a project log book containing weekly progress of the project.
4. At the end of the semester project group should complete the system design, Algorithm design and present with sui
5. Project report should be prepared using Latex and submitted in soft and hard form.

ODD Semester

Professional Elective (Theory) Courses

Title of the Course: (Professional Electives V)- High performance computing Course Code: 3CS411	L	T	P	Cr
	3	1	0	4

Pre-Requisite Courses: Data structures, Basic Programming knowledge.

Textbooks:

1. "Introduction to Parallel Computing", (2nd ed.), by Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar.
2. "High Performance Cluster Computing : Programming and Applications", Volume 2 By Buyya Raijkumar
3. "CUDA Programming: A Developer's Guide to Parallel Computing with GPUs", by shane cook

References:

Available online:

1. High Performance Computing, Charles Severance, 1998. http://cnx.org/content/col11136/latest/
2. MPI: The Complete Reference, Marc Snir, Steve Otto, Steven Huss-Lederman, David Walker, and Jack Dongarra, 1996. http://www.netlib.org/utk/papers/mpi-book/mpi-book.html
3. Designing and Building Parallel Programs, Ian Foster, 1995. http://www.mcs.anl.gov/~itf/dbpp/

Reference Books:-

1. "Parallel Programming in C with MPI and OpenMP", Michael J. Quinn, McGraw-Hill, 2004.

Course Objectives :

1. To be introduced with current trends in parallel computer architectures and programming models (i.e languages and libraries) for shared memory, manycore/multicore architecture.
2. To understand parallel program design methodology. Also to calculate speedup and efficiency of parallel algorithm.
3. To learn various parallel algorithms for matrices, graphs.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	describe different parallel paradigms , inter connection networks, and tools for parallel programming.	2	Understanding
CO2	demonstrate design methodology and performance measurement of parallel algorithms on various parallel platforms.	3	Applying
CO3	analyze a given problem for possibilities of parallel computations	4	Analyze

CO-PO Mapping :

	a	b	c	d	e	f	g	h	i	j	k
CO1	2	-	-	-	2	-	-	-	-	-	-
CO2	-	-	-	-	3	-	2	-	-	-	-
CO3	-	1	-	3	-	-	-	-	-	-	-

1: Low, 2: Medium, 3: High

Assessments: Teacher Assessment:

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MSE	30
ISE 2	10
ESE	50

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MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% weightage for course content (norm last three modules) covered after MSE.

Course Contents:

Module 1: Introduction What is parallel computing? The scope of parallel computing? Issues in parallel computing. Taxonomy of parallel architecture, Dynamic interconnection networks, static interconnection networks, Routing mechanism for static network. Communication cost in static interconnection network.	**7 Hrs.**
Module 2: Parallel programming models and paradigms. Introduction, A cluster computer and architecture, parallel applications and development, code granularity and level of parallelism, parallel programming models and tools, methodical design of parallel algorithm, parallel program paradigm, programming skeleton and templates.	**7 Hrs.**
Module 3: Performance and scalability of parallel systems Performance Metrics for parallel systems. The effect of Granularity and Data Mapping on Performance. The Scalability of parallel systems, Isoefficiency metric of scalability, sources of parallel overhead, Minimum execution time and minimum cost-optimal execution time.	**6 Hrs.**
Module 4: parallel programming libraries OpenMP, MPI, Thread basics ,Work Sharing constructs, Scheduling, Reduction, Mutual Exclusion Synchronization & Barriers, The MPI Programming Model, MPI Basics, Global Operations , Asynchronous Communication, Modularity, Other MPI Features, Performance Issues	**6 Hrs.**
Module 5: Parallel programming using accelerators Introduction of CUDA/OpenCL, Chapel, etc. Basics of GPGPU, CUDA Programming model, CUDA memory type, CUDA and/or OpenCL for GPGPU hardware, case study.	**6 Hrs.**
Module 6: Algorithms Dense matrix algorithms, sorting, graph algorithms.	**7Hrs.**

Module wise Measurable Students Learning Outcomes :

After the completion of the course the student should be able to:

Module1: Demonstration of basics of parallel computing platform.

Module 2: Comprehension of parallel algorithm design methodology.

Module 3: Computing performance of parallel algorithm.

Module 4: Implementation of parallel program with MPI, OpenMP.

Module 5: Explain CUDA Memory model and Architecture.

Module 6: Design of parallel algorithm for different data structures.

Title of the Course: (Professional Elective V) - Machine Learning	L	T	P	Cr
Course Code: 3CS 412	3	1	0	4

Pre-Requisite Courses: Basic Programming, Probability theory and linear algebra

Textbooks:

1. T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e, 2008
2. Christopher Bishop. Pattern Recognition and Machine Learning. 2e.

References:

1. http://nptel.ac.in
2. Tom M. Mitchell, Machine Learning, McGraw-Hill

Course Objectives :

1. To introduce some of the basic concepts of machine learning from a mathematically well motivated perspective
2. To cover the different machine learning paradigms and some of the popular algorithms and architectures used in each of these paradigms

Course Learning Outcomes:

CO	After completion of the course student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	explain fundamental issues and challenges and algorithms of machine learning	2	Understanding
CO2	demonstrate and use various algorithms and models with mathematical justifications	3	Applying
CO3	comprehend strengths and weaknesses of various machine learning approaches and use appropriate machine learning algorithms for real-world applications.	4	Analyzing

CO-PO Mapping :

	a	b	c	d	e	f	g	h	i	j	k	l
CO1	1	2	-	-	-	-	-	-	-	-	1	-
CO2	1	-	-	-	-	-	-	-	-	-	1	-
CO3	-	-	-	1	-	-	-	-	-	-	1	-

1: Low, 2: Medium, 3: High

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1 : Introduction	**7 Hrs.**
Introduction to Machine Learning, Concepts of Supervised and Unsupervised Learning, Statistical Decision Theory : Linear and Multivariate Regression, Dimensionality Reduction	
Module 2 : Linear Classification and SVM	**6 Hrs.**
Linear Classification, Linear Discriminant Analysis, Support Vector Machine	
Module 3 : Bayesian Learning and Decision Trees	**7 Hrs.**
Maximum Likelihood estimate, Priors and MAP estimate, Decision Trees	
Module 4 : Evaluation Measures and Hypothesis Testing	**6 Hrs.**
Evaluation Measures, Bootstrapping and cross validation, ROC curve	

Hypothesis Testing : Basics, Sampling Distributions and Z test, t-test	
Module 5 : Graphical and Gaussian Mixture Models	**7 Hrs.**
Graphical Models : Bayesian Networks, Hidden Markov Models Learning Theory and Expectation Maximization: Gaussian Mixture Model, Expectation Maximization	
Module 6 : Reinforcement Learning	**6 Hrs.**
Introduction to Reinforcement Learning, RL framework and TD learning, Applications	

Module wise Measurable Students Learning Outcomes :
After the completion of the course the student should be able to:

Module 1: Explain fundamentals of machine learning and decision theory
Module 2: Demonstrate the knowledge of Linear classification, support vector machines
Module 3: Demonstrate and use the concepts of Bayesian Learning and decision trees
Module 4: Explain and apply evaluation measures and hypothesis testing for problem solving
Module 5: Explain and use Graphical and Gaussian mixture models of machine learning
Module 6: Explain reinforcement learning, its framework and practical applications

Title of the Course: (Professional Electives VI) - Software Defined Networking Course Code: 3CS 414	L	T	P	Cr
	3	0	0	3

Pre-Requisite Courses: Computer Network(3CS222)

Textbooks:

1. SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies, By Thomas D. Nadeau, Ken Gray Publisher: O'Reilly Media, August 2013, ISBN: 978-1-4493-4230-2, ISBN 10:1-4493-4230-2.
2. Software Defined Networks: A Comprehensive Approach, by Paul Goransson and Chuck Black, Morgan Kaufmann, June 2014, Print Book ISBN: 9780124166752, eBook ISBN : 9780124166844

References:

1. SDN and OpenFlow for Beginners by Vivek Tiwari, Sold by: Amazon Digital Services, Inc., ASIN: , 2013.
2. Network Innovation through OpenFlow and SDN: Principles and Design, Edited by Fei Hu, CRC Press, ISBN-10: 14665094, 2014.

Course Objectives :

1. To understand SDN/NFV motivation and benefits
2. To describe how SDN/Openflow work
3. To describe OpenFlow operation and the OpenStack

Course Learning Outcomes:

CO	After completion of he course dent should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Explain and discuss the basic concepts and architecture of SDN in particular benefits brought about by the separation of data and control planes.	2	Understanding
CO2	Analyze and apply implementation of SDN through Open Flow Switches	3,4	Applying, Analyzing
CO3	critically evaluate t he pros and cons of applying SDN, API approaches, Hypervisor overlays, and Data Center SDN	5	Evaluating

CO-PO Mapping :

	a	b	c	d	e	f	g	h	i	j	k
CO1	-	2	-	3	-	-	-	-	-	-	2
CO2	-	-	-	2	3	-	-	-	-	-	1
CO3	-	-	-	3	1	-	-	-	-	-	1

1: Low, 2: Medium, 3: High

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30

ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1	**Hrs.**
History and Evolution of Software Defined Networking (SDN): Separation of Control Plane and Data Plane, IETF Forces, Active Networking. Control and Data Plane Separation: Concepts, Advantages and Disadvantages, the OpenFlow protocol.	**8**
Module 2	**Hrs.**
Network Virtualization: Concepts, Applications, Existing Network Virtualization Framework (VMWare and others), Mininet based examples.	**6**
Module 3	**Hrs.**
Control Plane: Overview, Existing SDN Controller including Floodlight and OpenDaylight projects. Customization of Control Plane: Switching and firewall, Implementation using SDN Concepts.	**6**
Module 4	**Hrs.**
Data Plane: Software-based and Hadrware-based; Programme Network Hardware. Programming SDNs: Northbound A plication Programming Interface, current Languages and Tools, Composition of SDNs.	**6**
Module 5	**Hrs.**
Network Functions Virtualization (NFV) and Software Defined Networks: Network architecture, NFV Infrastructure NFV Management and Orchestration (MANO), NFV and SDN	**6**
Module 6	**Hrs.**
Data Center Networks: Packet, Optical and Wireless Architectures, Network Topologies. Use Cases of SDNs: Data Centers, Internet Exchange Points, Backbone Networks, Home Network , Traffic Engineering	**7**

Module wise measurable Students Learning Outcomes :
After the completion of the course the student should be able to:

Module 1: explain the basic concepts and architecture of SDN in particular benefits brought about by the separation of data and control planes.
Module 2: describe network virtualization.
Module 3: explain in detail the operation of the SDN control plane.
Module 4: describe the SDN data plane.
Module 5: describe Network Functions Virtualization components and how they work together.
Module 6: understand Data center networks and use cases of SDNs.

Title of the Course: (Professional Elective VI) - Software Design and Architecture **Course Code: 3CS 415**	L	T	P	Cr
	3	-	-	3

Pre-Requisite Courses: None

Textbook:

1. David Budgen, "Software Design", 2nd edition, Pearson Education (LPE)
2. Software Design: From Programming to Architecture Eric J. Braude ISBN: 978-0-471-20459-6
3. Software Architecture in Practice, 3rd Edition By Len Bass, Paul Clements, Rick Kazman Published Sep 25, 2012 by Addison-Wesley Professional

References:

1. Applied Software Architecture ,Christine Hofmeister, Robert Nord, Deli Soni, Addison-Wesley Professional; 1st edition (November 4, 1999)
2. Enterprise Patterns and MDA: Building Better Software with Archetype Patterns and UML, Jim Arlow, Ila Neustadt ,Addison-Wesley Professional, 2004.
3. Kai Qian, Xiang Fu, Lixin Tao, "Software Architecture and Design lluminated", Jones & Bartlett Learning, 2009.

Course Objectives :

1. To discuss concepts, processes and practices of Software Design
2. To explain technologies and components of business intelligen systems
3. To model and analyze multidimensional data
4. To apply business intelligence in s cific application domains
5. To have hands-on with BI implem tation using open source / commercial tools

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	explain the method methods for designing new software solutions.	2	Understanding
CO2	recognize major software architectural styles, design patterns, and Frameworks.	4	Analyzing
CO3	evaluate the scenarios in object oriented software architecture.	5	Evaluating
CO4	design architecture for large-scale software systems.	6	Creating

CO-PO Mapping :

	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
CO1	-	3	3	-	-	-	-	-	-	-	-
CO2	-	-	-	-	3	-	-	-	-	2	-
CO3	2	3	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	3	-	-	2	-	-	-

1: Low, 2: Medium, 3: High

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE

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Course Contents:

Module 1: Software Design Process Role of Software Design, Software design process, nature of design process, design qualities; Transferring Design Knowledge: describe design solution, transferring design knowledge, design notations, design strategies.	**6 Hrs.**
Module 2: Software Design strategies Creational, Structural, behavioral design patterns, Component based design, Formal Approach to design. Role of design strategy - Describing the design process as D-Matrix, Design by top-down decomposition , Design by composition, Function-oriented design, Object-oriented design, Data-Centered design, Aspect oriented design	**7 Hrs.**
Module 3: Introduction to Software Architecture What Is Software Architecture? Why Is Software Architecture important? Quality Attributes, Architecture and Requirements, Designing an Architecture, Do menting software Architecture, Architecture and Software Product lines	**6 Hrs.**
Module 4: Software Architecture Design Designing, Describing, and Using Software Architecture, IS-2000: Th Advanced Imaging Solution, Global Analysis, Conceptual Architecture View, Module Architecture View, Styles of the Module Viewtype, Execution architecture View, Code Architecture View. Component-and-Connector Viewtype, St es of Component-and-Connector View type, Allocation Viewtype and Styles.	**7 Hrs.**
Module 5: Archetype Patterns Archetypes and Architecture Patterns, Model Driven Architecture with Archetype Patterns. Literate Modeling, Architecture Pattern. , Customer Relationship Management (CRM) Archetype Pattern, Product A chpe Pattern, Quantity Archetype Pattern, Rule Archetype pattern.	**7 Hrs.**
Module 6: Software Architectures Object-Oriented Paradigm Object-Oriented Paradigm, Da low Architectures, Data-Centered Software Architecture, Hierarchical Architecture, Interaction Oriented Software Architectures, Distributed Architecture, Component-Based Software Architecture, Heterogeneous Architecture, Architecture of User Interfaces, Implicit asynchronous communication software architecture.	**6 Hrs.**

Module wise Measurable Students Learning Outcomes :
After the completion of the course the student should be able to:

Module 1: Explain Role of Software Design, Software design process**.**
Module 2: Demonstrate Object Oriented Design.
Module 3: Comprehend Software Architecture design specifications.
Module 4: Apply software design methodologies.
Module 5: Recognize major software architectural styles, design patterns, and frameworks
Module 6: Describe a software architecture types and scenarios.

Title of the Course: (Professional Elective VI) - RTOS and Embedded Systems **Course Code: 3CS 416**	L	T	P	Cr
	3	-	-	3

Pre-Requisite Courses: None

Textbook:

1. Marilyn Wolf, "Computers as Components: Principles of Embedded Computing Systems Design", Third Edition, Morgan Kaufmann, 2012.
2. Arnold S. Berger, "Embedded Systems Design: An Introduction to Processes, Tools, and Techniques", CMP Books, 2001.
3. Alan C. Shaw, "Real-Time Systems and Software", Wiley, 2001.
4. Quing Li, "Real-Time Concepts for Embedded Systems", Elsevier / CMP Books, 2011.

References:

1. Doug Abbott, "Linux for embedded and real time applications", Elsevier Science, 2003.
2. "Getting started with RT-Linux", FSM Labs., Inc.
3. pSOS reference manual/ programmers manual.
4. Nucleus RTOS reference manual/ programmers manual.
5. Micro C OS II reference manual/ programmers manual

Course Objectives :

1. To understand hardware platform for embed systems.
2. To conceptualize embedded system from given requirement
3. To study an open-source RTOS System RT-Linux
4. To understand capabilities of at least one commercial off-the-shelf R kernel

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	explain hardware platforms, typical processors and development lifecycle of embedded systems	2	Understanding
CO2	analyze Process level management in RT-Linux	5	Analyzing
CO3	design multi-tasking embedded system with RTOS	6	Creating

CO-PO Mapping :

	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
CO1	1	-	3	2	-	-	-	-	-	-	-
CO2	-	-	-	-	3	-	-	-	-	1	-
-	-	-	-	-	-	-	-	-	-	-	1

1: Low, 2: Medium, 3: High

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50
ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.	

MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1: Embedded Computing and Processors Introduction to embedded computing – overview of embedded system design process – instruction sets of processors: ARM, PIC, TI C55x, programming I/O – modes and exceptions – coprocessors – memory system – CPU performance – CPU power consumption. Design example: Audio Player.	**7 Hrs.**
Module 2: RTOS Basics Resources and Share resources, Communicating between Tasks, Intertask Communication and Synchronization Overview, Messages and Message Queues, Semaphores: Binary and Counting Semaphores, Priority Inversion, Mutexes: Priority Inheritance and Priority Ceiling.	**6 Hrs.**
Module 3: RTOS Kernel Operations What is process? Process Scheduling and algorithm, Foreground and background systems, Resources and Shared resources, Multitask Management - Stagess of task, Context Switch(Time and memory management), Scheduler Kernel, Non preemptive kernel and pre-emptive kernel Reentrant and Non Reentrant function, Dynamic Memory Allocation: Fragmentation Issues, RTOS Timers: Relative and Absolute Timing, Asynchronous Sign Device I/O Supervisor	**6 Hrs.**
Module 4: Overview of Embedded Linux: Linux file system, Basics regarding Kernel space and its interface to User Space, Shell and basic shell commands, Basic IP Filters, Linux Memory Model, Linux Scheduling and priorities	**7 Hrs.**
Module 5: RTOS Systems – Case Studies Understanding working principle of RTOSes viz. pS Nucleus, micro-C/OS. Study of Performance benchmark RTOSes.	**7 Hrs.**
Module 6: Embedded System Design and Analysis Components for embedded programs – des of programs – Assembly, linking, and loading compiler optimization – program-level performance analysis – performance optimization – program-level energy optimization – optimizing program size – program validation and testing – design example: Digital Camera	**6 Hrs.**

Module wise Measurable Students Learning Outcomes :
After the completion of the course the student should be able to:
Module 1: Explain various platforms and processes used for embedded applications**.**
Module 2: Describe basic operations used in RTOS.
Module 3: Explain processes and IPC.
Module 4: Describe the Basics of Embedded Linux
Module 5: Study various commercial RTOSes and their performance analysis
Module 6: Employ best practices in embedded software engineering

ODD Semester

Open Electives Courses

Title of the Course: (Open Elective III) - Business Intelligence **Course Code: 1OE471**	L	T	P	Cr
	3	-	-	3

Pre-Requisite Courses: Database Management System, OLAP, Some concepts of Mathematics and Statistics.

Textbook:

1. R.N. Prasad and Seema Acharya *"Fundamentals of Business Analytics"*, Wiley publication
2. GalitShmueli, Nitin R. Patel, Peter C. Bruce, " Data Mining for Business Intelligence:- Concepts, Techniques and Applications in MS-Office Excel with XLMiner", Wiley India

References:

1. Margaret H. Dunham, *Data Mining: Introductory and Advanced Topics*, Pearson Education
2. Ralph Kimball, Ross, *"The Data Warehouse Lifecycle Toolkit"*, 2nd edition, Wiley Publication
3. Anahory& Murray, *"Data Warehousing in the Real World"*, Pearson Edt.
4. White papers and manuals/documentation from Oracle / IBM / Microsoft site on BI suite/tools.

Course Objectives :

1. To discuss concepts and practices of business intelligence and decision support
2. To explain technologies and components of business intelligence systems
3. To model and analyze multidimensional data
4. To apply business intelligence in specific application domain
5. To have hands-on with BI implementation using open source / commercial tools

Course Learning Outcomes:

CO	**After the completion of the course th student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	interpret the basic issues in BIS and become familiar with the various BI processes	2	Understanding
CO2	compare and contrast different emerging architectures of BI systems	4	Analyzing
CO3	appraise or evaluate BI Techniques	5	Evaluating
CO4	design the BI models using different open source and commercial BI tool	6	Creating

CO-PO Mapping :

	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
CO1	3	2	-	-	-	-	-	-	-	-	1
CO2	-	3	-	2	-	-	-	-	-	-	-
CO3	-	-	-	3	2	-	-	-	-	-	-
CO4	-	-	3	-	2	-	1	-	-	-	3

1: Low, 2: Medium, 3: High

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1: Introduction to Business Intelligence Introduction to digital data and its types – structured, semi-structured and unstructured, Introduction to OLTP and OLAP (MOLAP, ROLAP, HOLAP).	**6 Hrs.**
Module 2: Basics of BI BI Definitions & Concepts, BI Framework, Data Warehousing concepts and its role in BI, BI Infrastructure Components – BI Process, BI Technology, BI Roles & Responsibilities, Business Applications of BI, BI best practices	**7 Hrs.**
Module 3: Data Integration & Data Processing Concepts of data integration, needs and advantages of using data integration, introduction to common data integration approaches, Meta data –types and sources. Introduction to data quality, data profiling concepts and applic ions	**6 Hrs.**
Module 4: Measures, Metrics, KPIs, and Performance Mana ment. Understanding Measures and performance, Measur ent System minology, navi ating a Business enterprise, Role of metrics, metrics supply chain, fact-based ecision making, KPIs, KPIs Usage in Companies, where do Business metrics and KPIs come m? Connecting the dots.	**7 Hrs.**
Module 5: Designing & Developing B.I Applications B.I. Application resource planning, B.I. application Specification, B.I. Application Development, B.I. Application maintenance, BI Cloud Computing.	**7 Hrs.**
Module 6: Case study: open source / commercial BI tools Oracle / IBM / Microsoft BI tools : architectures, design and deployment of BI in different domains using these tool	**6 Hrs.**

Module wise Measurable Students Learning Outcomes :
After the completion of the course the student should be able to:

Module 1: Explain the types of data and processing**.**
Module 2: Explain BI basics and apply to application.
Module 3: Demonstrate and hands on data integration techniques.
Module 4: Describe Business metric and KPI.
Module 5: Explain design, development and maintenance of BI applications.
Module 6: Demonstrate the BI implementations using various tools

ODD Semester

Mandatory Life Skill Courses

Title of the Course: Engineering Management and Ethics Course Code: 3IC401	L	T	P	Cr
	4	-	-	4

Pre-Requisite Courses: NIL

Textbooks:

1. Management: Theory and Practice; A.I.T.B.S. Publishers, Delhi. - N.C. Jain, Saakhshi
2. Principles and Practice of Management - L.M. Prasad
3. Principles of Management; Himalaya Publishing House - T. Ramasamy
4. Modern micro economic theory – H.L. Ahuja, S.Chand.
5. Engineering economics – Sullivan, Wicks, Koelling – Pearsons.

References:

1. Principles of Management; P.C. Tripathi and P.N. Reddy, Tata McGraw Hills Pub. Company Ltd.,
2. Business Management; - J. C. Sinha, V. N. Mugata, S. Chand & Co., New Delhi
3. Principles of Management - Koontz and O'Donnell
4. Management: A Functional Approach - Joseph M. Putti
5. Stonier & Hague – A text book of economic theory, Pearson
6. Industrial organization and engineering economics – Banga and Sharma

Course Objectives :

1. To provide insight into management, economics and ethics.
2. To manage effectively business operations and project management teams.
3. To meet the challenges for contemporary professional practice; be able to adapt and solve the increasingly complex management problems faced by industry.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Perceive and describe key management theories and approaches, economics terminologies and organizational / business ethics.	2	Understanding
CO2	Grasp the market scenario and apply the principles of financial, production and Human Resource management.	3	Applying
CO3	Examine various cost factors for different alternatives in project situations and make optimal economic decisions.	4	Analyzing

CO-PO Mapping :

	a	b	c	d	e	f	g	h	i	j	k
CO1											
CO2											
CO3											

1: Low, 2: Medium, 3: High

Assessments :

Teacher Assessment:

ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Course Contents:

Module 1: Basics of Management Management: Definition, objectives, Nature & importance of management, management approaches, principles of management, managerial roles & skills, Recent trends & challenges of management in Global scenario. Taylor's Scientific Management, Fayol's Principles of Management, Douglas Mc-Gregor's Theory, X and Theory Y, Mayo's Hawthorne Experiments, Hertzberg's Two Factor Theory of Motivation, Maslow's Hierarchy of Human Needs	**5 Hrs.**
Module 2: Principles of Management **Planning:** Meaning, Importance, Planning process; Types of Plans - Objectives, Strategy, Policy, Procedure, Method, Plan vs. Programme, Decision making, types of decision, Decision Making steps Forecasting methods **Organizing:** Definition, Nature & purpose, Principles, Process, Types and structure of organization **Staffing:** Nature & purpose, recruitment policies and selection procedure, Induction/orientation, carrier development, carrier stages & performance appraisal Directing and Co-ordination: **Directing:** Concept and importance, creativity & innovation, Elements of Directing - Supervision, Motivation (Theories), Leadership (styles & theories), Communication (Barriers to effective communication) **Co-ordination:** Concept and Importance, Limitations; Types- Internal and External; Coordination-the Essence of Management **Controlling:** Concept and importance, Limitations, process of controlling, Requirements of good control system, Types of control, Techniques of Control, Relationship between Planning and Controlling; Change Management	**10 Hrs.**
Module 3: Introduction to Functional areas as Marketing Management **Financial Management**: Scope, Sources of finance, capital types, financial statements, balance sheets, Profit & Loss A/C **Production Management**: Objectives, Site selection & factors affecting site selection , plant layout (objectives, principles, merit & demerit of each type) **Human Resource Management:** Introduction, Importance, Functions of H.R.M, Job evaluation & different types of evaluation methods, Recruitment Process- Selection, Training and Development- Methods, Performance Appraisal, Functions of Personnel Manager.	**5 Hrs.**
Module 4: Introduction to Engineering Economics **Introduction to Economics:** Definition , Nature of economic problem, Scope, Difference between Microeconomics & Macroeconomics, Meaning of demand & supply, elasticity of demand, demand forecasting methods, market equilibrium, practical importance & applications of the concept of elasticity of demand, Economic evaluation of project by: (i) Present worth method (ii) Future worth method (iii) I.R.R. Method **Theory of production:** factors of production (meaning & characteristics of Land, Labour, Capital, Entrepreneur & organizations), law of variable proportion, return to scale, Internal and External economics and diseconomies of scale. Cost - Meaning, short & long run cost, fixed cost, variable cost, direct and indirect costs, total cost, average cost, marginal cost, concept of cash flow & revenue, break-even analysis Theories of demand – Law of demand & supply, Cardinal Utility, indifference curve, Consumer equilibrium, consumer surplus, Revealed preference approach	**12 Hrs.**
Module 5: Market Structure **Market** : Definition, types of market their characteristics, (Perfect competition, Monopoly, Oligopoly, Monopolistic competition), Role of demand & supply in price determination imperfect competition **National Income –** Definition, concept of national income, Methods of calculation, Meaning of GNP, GDP, GNI, NNP, NDP, NNI, Green GDP, PCI, Types, Causes and effects of Inflation, measures to control.	**4 Hrs.**

Module 6: Ethics in Business/ Professional ethics: Business Ethics: Need, Concept and elements, importance, characteristics & principles of business ethics, advantages of managing ethics in workplace, Ethics in business, Role of ethics in organizational culture, Challenges of business ethics and corporate leadership, Ethical principles in business – Indian perspective	**4 Hrs.**		

EVEN Semester

EVEN Semester

Professional Core (Lab) Courses

Title of the Course: Project-II Course Code: 3CS492	L	T	P	Cr
	-	-	$16	10

Pre-Requisite Courses: Nil

Textbook: Nil

References: Nil

Course Objectives :

1. To undergo project management techniques
2. To apply project design principles using latest tools and technologies
3. To develop analytical vision and skills to analyse, compare the outcome with other techniques
4. To write and publish deliverable technical artifacts for the project

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	work in teams and participate in group activity of software development.	3	Applying
CO2	demonstrate different product development phases through appropriate selection of software tool for project implementation.		Evaluating
CO3	develop a software product	6	Creating
CO4	analyse performance of developed product and Write/publish technical artifacts	4	Analyse

CO-PO Mapping :

	a	b	c	d	e	f	g	h	i	j	k
CO1	-	-	-	-	-	-	-	3	2	-	-
CO2	-	-	-	-	3	-	-	-	2	3	-
CO3	-	-	2	3		-	-	-	-	-	2
CO4	-	-	-	-	2	-	-	-	2	-	-

1: Low, 2: Medium, 3: High

Assessment:

Lab Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.
IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

Week 1 indicates starting week of Semester.
Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course.
The experimental lab shall have typically 8-10 experiments.

Course Contents:

1. Preferably project work is to be continued from Project-I
2. Students should maintain a project log book containing weekly progress of the project
3. At the end of the semester project group should achieve all the proposed objectives of the problem statement.
4. The work should be completed in all aspects of design, implementation and testing.
5. Project report and technical artifacts should be prepared, submitted in soft and hard form

along with all the code and datasets. 6. Group should demonstrate the work with various test cases and results obtained and explain future scope. 7. The group should participate in technical symposiums, paper presentations to demonstrate their work and findings in technical community.	

Title of the Course: Techno-Socio Outreach **Course code: 3CS493**	L	T	P	Cr
	1			1

Pre-Requisite Courses: This is the audit course. No pre-requisite

Textbook:

No prescribed text book as such.

References:

The students may refer/undergo on line courses required to undertake any techno-socio activity.

Course Objectives :

1. To promote / motivate the students for co-curricular activity
2. To develop the ability of "Out of Box" thinking.
3. To apply the knowledge acquired in engineering to solve nationwide, society and community problem.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	analyze real world problem.	4	Analyzing
CO2	Demonstrate the solution to techno-socio problem	6	Creating

CO-PO Mapping :

	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
CO1											1
CO2											2
CO3											

Assessments :

Teacher Assessment:

Four Components of End Semester Examination (ESE) having 25% weights for each semester from 5^{th} to 8^{th}.

Assessment	Marks
ESE 1 [TY Sem-1]	25
ESE 2 [TY Sem-2]	25
ESE 3 [Final Year Sem-1]	25
ESE 4 [Final Year Sem-2]	25
Each ESE will be based on the type of techno-socio activity (refer rubrics for each) listed in course contents:	

Course Contents:

Open to students. Student can undertake any techno-socio activity as listed below but not limited to it :

1. Each student or group of students may participate in any social activity like “Swach Bharat Abhiyan”, “Blood Donation Camp”, or any social activity announced by Govt. / Corporation / Panchayat.
2. Each student or group of students participating in technical events / competition.
3. Awards / recognition received in techno-socio activity
4. Completing the on line courses (on topics beyond syllabus) / certification of any companies / technologies (e.g. IBM / Oracle / CISCO etc.)
5. Developing any innovative gadget / solution / system and transfer in the interest of Nation / Society / Institute (WCE)
6. Published a papers in national / international conferences / journals
7. Coordinating the students clubs / services
8. Organizing techno-socio activity for the students / community in rural areas, backward areas.

EVEN Semester

Professional Elective (Theory) Courses

Title of the Course: (Professional Electives VII) - **Computer Forensics** **Course Code: 3CS 431**	L	T	P	Cr
	3	0	0	3

Pre-Requisite Courses: Information Security and Operating System.

Textbooks:

1. Digital Forensics with Open Source Tools. Cory Altheide and Harlan Carvey, ISBN: 978-1-59749586-8, Elsevier publication, April 2011
2. Computer Forensics and Cyber Crime: An Introduction (3rd Edition) by Marjie T. Britz, 2013.

References:

1. Network Forensics: Tracking Hackers Through Cyberspace, Sherri Davidoff, Jonathan Ham Prentice Hall, 2012
2. Guide to Computer Forensics and Investigations (4th edition). By B. Nelson, A. Phillips, F. Enfinger, C. Steuart. ISBN 0-619-21706-5, Thomson, 2009.
3. Computer Forensics: Hard Disk and Operating Systems, EC Council, September 17, 2009

Course Objectives :

1. To provide an understanding of Computer forensics fundamentals.
2. To describe the implementation of computer file systems in at least two operating systems.
3. Handle evidence without compromising it, and analyse it for presentation in a court of law.

Course Learning Outcomes:

CO	**After completion of the course student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	discuss how to secure evidence a computer, network, or other electronic storage device.	2	Understanding
CO2	analyze the contents of various electronic age devices using computer forensic tools.	4	Analyzing
CO3	demonstrate how to handle evidence without compromising it, and analyze it for presentation in a court of law.	3	Applying

CO-PO Mapping :

	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
CO1	-	3	-	3	2	1	-	-	-	-	-
CO2	-	2	-	-	1	3	-	-	-	-	-
CO3	-	3	-	-	1	2	-	-	-	-	1

1: Low, 2: Medium, 3: High

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last

three modules) covered after MSE.

Course Contents:

Module 1	**Hrs.**
Introduction to Computer Forensics: Computer crimes, evidence, extraction, preservation, etc. Overview of hardware and operating systems: structure of storage media/devices; windows/ Macintosh/ Linux -- registry, boot process, file systems, file metadata.	**7**
Module 2	**Hrs.**
Data recovery: identifying hidden data, Encryption/Decryption, Steganography, recovering deleted files. Digital evidence controls: uncovering attacks that evade detection by Event Viewer, Task Manager, and other Windows GUI tools, data acquisition, disk imaging, recovering swap files, temporary &cache files	**7**
Module 3	**Hrs.**
Computer Forensic tools: Encase, Helix, FTK, Autopsy, Sleuth kit Forensic Browser, FIRE, Found stone Forensic ToolKit, WinHex, Linux dd and other open source tools.	**7**
Module 4	**Hrs.**
Network Forensic: Collecting and analyzing network-based evidence, reconstructing web browsing, email activity, and windows registry change intrusion detect on, tracking offenders, etc.	**6**
Module 5	**Hrs.**
Software Reverse Engineering: d end against software targets for viruses, worms and other malware, improving third-party software library, identifying hostile codes-buffer overflow, provision of unexpected inputs, etc.	**6**
Module 6	**Hrs.**
Computer crime and Legal issues: Intellectual property, privacy issues, Criminal Justice system for forensic, it/investigative situations and digital crime scene, investigative procedure/standards for extraction, preservation, and deposition of legal evidence in a court of law, Case Studies in Computer Forensics.	**7**

Module wise Meas able Students Learning Outcomes :

Module 1: Describe the puter forensics fundamentals

Module 2: Illustrate the methods for data recovery, evidence collection and data seizure.

Module 3: Evaluate the effectiveness of available digital forensics tools and use them in a way that optimizes the efficiency and quality of digital forensics investigations.

Module 4: Explain how to collect and analyze the network-based evidences.

Module 5: describe how to defend against malwares.

Module 6: analyse the data to identify evidence, technical aspects & legal aspects related to cybercrime.

Title of the Course: Search Engine Design and Optimization **Course Code: 3CS 432**	L	T	P	Cr
	3	0	0	3

Pre-Requisite Courses: Basic Programming, Probability theory and linear algebra

Textbooks:

. Moz, The Beginners Guide to SEO (Web Down Loadable)
. AARON MATTHEW WAL L "Search Engine Optimization Book" (Web Down Loadable)

References:

. Ricardo Baiza Yates " Modern Information Retrieval" Addison-Wesley ACM Press
. https://www.tutorialspoint.com/seo/seo_tutorial.pdf
. W.Bruce Croft, Donald Metzler, Trevor Strohman "Search Engines Information Retrieval in Practice"

Course Objectives :

. To understand detailed functions of search engines.
. To evaluate the different search engine designs.
. To emphasize on optimizing design of search engines.
. To study the measurements on search results

Course Learning Outcomes:

CO	After completion of the course student should be able to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	explain fundamental issues an challenges of search engines	2	Understanding
CO2	demonstrate various algorithms for search operations	3	Applying
CO3	comprehend strengths and weaknesses of various search engines and use appropriate measures for search results for real world applications	4	Analyzing

CO-PO Mapping :

	a	b	c	d	e	f	g	h	i	j	k
CO1	1	2	-	-	-	-	-	-	-	-	1
C 2	1	-	-	-	-	-	-	-	-	-	1
CO3	-	-	-	1	-	-	-	-	-	-	1

1: Low, 2: Medium, 3: High

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1 : Introduction	**Hrs.**
How Search Engine Operates: Crawling and Indexing, Providing Answers, Examples	**7**

How people interact with search engines.	
Module 2 :	**Hrs.**
Basics of Search Engine Design and Development: Indexable content, Crawlable Link Structures, Keyword Usage and Targeting, On-Page Optimization, Meta Tags, URL Structures, Construction Guidelines,	**6**
Module 3 : Keyword Research,	**Hrs.**
How to judge the value of a keyword, understanding the long tail of keyword demand,	**7**
Module 4 : Usability and user experience	**Hrs.**
Impact of usability and user experience, signals of quality content, crafting content,	**6**
Module 5 : Growing popularity and links	**Hrs.**
Link signals, Link building basics	**7**
Module 6 : Search Engine tools and tracking success	**Hrs.**
Common search engine protocols, Search engine tools, Measuring and tracking success	**6**

Title of the Course: Storage Systems **Course Code: 3CS 433**	L	T	P	Cr
	3	0	0	3

Pre-Requisite Courses:

Computer networking

Textbooks:

G. Somasudaram, "*Information Storage and Management*", EMC EducationServices (Wiley India Edition)

References:

1. Ulf Troppen, Rainer Erkens, Wolfgang Müller,, "Storage Networks Explained"(Wiley India Edition).
2. Robert Spalding, "Storage Networks: The complete Reference", TMH.
3. Tom Clark, "Designing Storage Area Networks", A Practical Reference for implementing Fibre Chanel and IP SANs
4. NPTEL: http://nptel.ac.in Storage Systems by Dr K. Gopinath, Department of Computer Science & Automation ,Indian Institute of Science ,Bangalore

Course Objectives :

1. To introduce storage technologies
2. To get acquainted with Storage system architectures
3. To categorize storage networking, backup and recovery technologies
4. To provide knowledge about large storage systems

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	describe components of a storage infrastructure including various storage systems, backup and recovery technologies.	2	Understanding
CO2	use the knowledge of storage, virtualization, backup and recovery technologies for building storage systems.	3	Applying
CO3	identify and differentiate various storage systems, backup and recovery technologies for different application in business continuity.	4	Analyzing

CO-PO Mapping :

	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
CO1	-	2	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	1	-	-	-	-
CO3	-	2	-	-	3	-	1	-	-	-	-

1: Low, 2: Medium, 3: High

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules) ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1	**Hrs.**
Introduction to information storage and Storage and Management Information Storage, Evolution of Storage Technology and Architecture, Data Center Infrastructure, Key Challenges in Managing Information, Information Lifecycle, Storage System Environment: Components of a Storage System Environment, Disk Drive Components, Disk Drive Performance, Fundamental Laws Governing Disk Performance, Logical Components of the Host, Application Requirements and Disk Performance.	**7**
Module 2	**Hrs.**
Data Protection: RAID, Intelligent Storage System Implementation of RAID, RAID array components, RAID levels, Comparison, RAID Impact on disk performance, Hot Spares, Intelligent Storage System: Components of an Intelligent Storage System, Intelligent Storage Array	**6**
Module 3	**Hrs.**
Direct-Attached Storage, SCSI, SAN, NAS Types of DAS, DAS Benefits and Limitations, Introduction to Parallel SCSI, SCSI Command Model. Storage Area Network: Fibre Channel: Overview, The SAN and its Evolution, Components of SAN, Fibre Channel (FC) Connectivity, Ports, Architecture, Technology, Network-Attached Storage (NAS): Benefits, file I/O, Components, Implementations, File sharing Protocols, I/O operations, Factors affecting NAS Performance and Availability.	**7**
Module 4	**Hrs.**
IP SAN, Content-Addressed Storage, Storage Virtualization iSCSI, FCIP, Fixed Content and Archives, Types of Archives, Features and Benefits of CAS, CAS Architecture, Object Storage and Retrieval in CAS, CAS Examples, Storage Virtualization: Forms of Virtualization, SNIA Storage Virtualization Taxonomy, Storage Virtualization Configurations, Storage Virtualization Challenges, Types of Storage Virtualization.	**6**
Module 5	**Hrs.**
Business Continuity, Backup and Recovery Introduction, Information Availability, BC terminology, BC planning life cycle, Failure Analysis, Business Impact Analysis, BC Technology Solutions, Backup and Recovery: Backup Purpose, Backup considerations, Backup	**7**

Granularity, Recovery considerations, Backup Methods, Backup Process, Backup and Restore Operations, Backup Topology, Backup in NAS environment, Backup Technologies,	
Module 6	**Hrs.**
Replication: Local Replication: Source and Target, Uses of Local Replicas, Data Consistency, Local Replication Technology, Restore and Restart Considerations, Introduction to Remote Replication **Large Storage Systems:** Google FS/BigTable, Cloud/Web-based systems (Amazon S3), FS+DB convergence, Programming models: Hadoop	**7**

Module wise Measurable Students Learning Outcomes :

Module 1: Explain the basic components of storage architecture.

Module 2: Identify various methods for effective and protective storage.

Module 3: Compare and analyze various storage technologies.

Module 4: Compare and analyze various virtualization technologies.

Module 5: Apply systematically techniques for easy and fast data recover.

Module 6: Explain replication and current technologies of large storage systems.

This is Last Page