COURSE STRUCTURE

For

B.TECH. DEGREE

in

COMPUTER SCIENCE & ENGINEERING

(Applicable from the academic session 2024-2025)

Dr. B. C. Roy Engineering College

An Autonomous Institution

Approved by: All India Council for Technical Education (AICTE)
Affiliated to: Maulana Abul Kalam Azad University of Technology, West Bengal
(Formerly Known as -WBUT)

Jemua Road, Durgapur, West Bengal, India, 713206

□□The first year course structure (Page 3 and Page 4) is unanimously accepted and approved in the first BoS meeting held in the Department of a) Physics, b) Chemistry, c) Mathematics, d) English, e) Electrical Engineering, f) Electronics and Communication Engineering, g) Computer Science and Engineering, h) Mechanical Engineering.
□ The BoS of CSE (Computer Science and Engineering) in its first meeting (held in the Department of CSE (Computer Science and Engineering) on 6th November 2024 has unanimously accepted and approved the four year course structure of CSE (Computer Science and Engineering).

Head
Dept. Computer Science & Eng
Dr. B. C. Roy Engineering College
Durgapur

Semester 7								
Sl No	**Course Type**	**Paper Code**	**Paper Name**	**Marks**	**L**	**T**	**P**	**Credit**
Theory								
1	HM	CS-701	Human Resource Development & Organizational Behavior	100	3	0	0	3
2	PE	CS702-711	Core Elective IV: Cloud Computing / Neural Network & Deep Learning / Natural Language Processing / Mobile Computing	100	3	0	0	3
3	PE	CS712-721	Core Elective V: Data Analytics / Cyber Security / Quantum Computing / High Performance Computing	100	3	0	0	3
4	OE	CS722-731	Open Elective III: E-Commerce & ERP / Industrial Management / Game Theory & Applications / Bio-Informatics / Social Network Analysis	100	3	0	0	3
			Total Theory	400	12	0	0	12
5	PROJ	CS781	Project II	100	0	0	12 (S*)	6
6		CS782	Industrial Training & Seminar	100	0	0	2 (S*)	1
Total Credits								**19**

Course Name: Human Resource Development & Organizational Behavior

Course Code: HM CS701

(Semester- VII)

Category: Major

Course Broad Category: Engineering Science Course

[For Computer Science and Engineering]

1. **Course Prerequisite:**

2. **Course Learning Objectives:**
   i. To learn the Organizational Behaviors .
   ii. To learn about perception, nature , importance , factors influencing perception.
   iii. To gain knowledge about group behaviour.
   iv. To learn about organizational politics.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions, and Case Studies.
   Evaluation System –
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.

4. **Course Content**
   Course Name: Human Resource Development & Organizational Behavior
   Course Code: HM CS701
   Hours per Week: 3L
   Credits: 3

Module	Topics	Lectures
Unit 1	Organizational Behaviour: Definition, Importance, Historical Background, Fundamental Concepts of OB, Challenges and Opportunities. Personality Basics: Definition, determinants, traits, and development. Attitudes: Types and characteristics. Job Satisfaction: Key concepts and linkages to attitudes/personality.	6
Unit 2	Perception: Factors influencing perception, Perceptual selectivity, Link between perception and decision-making. Motivation: Definition, Maslow's Hierarchy of Needs, McGregor's Theory X and Y, Herzberg's Motivation-Hygiene Theory, Alderfer's ERG Theory, McClelland's Theory of Needs, Vroom's Expectancy Theory.	10
Unit 3	Formation and development of groups, Stages of group decision development, Group communication and decision-making processes. Communication process and models, Directions of communication (downward, upward, lateral), Barriers to effective communication and strategies to overcome. Definition and importance of leadership, Key theories and leadership styles (e.g., trait, behavioral, contingency approaches).	8
Unit 4	Organizational Politics: Definition and nature of organizational politics, Factors contributing to political behavior. Conflict Management: Traditional vs. modern views of conflict, Functional and dysfunctional conflict, Conflict process, negotiation strategies, and bargaining process. Organizational Design: Various organizational structures and their effects on human behavior, Concepts of organizational climate and culture.	8

5. **References:**
Text & References Books:

- Robbins, S. P. & Judge, T.A.: Organizational Behavior, Pearson Education, 15th Edn.
- Luthans, Fred: Organizational Behavior, McGraw Hill, 12th Edn.

6. **Course Outcomes:**
After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Understand the necessity, development, numerous classification, and design issues of the operating system.	Understand	L2
CO2	Apply different methods for implementing processes and threads as well as the various process scheduling algorithms.	Apply	L3
CO3	Identify different challenges associated with deadlock, concurrency, and different synchronization mechanisms	Identify	L1
CO4	Analyze several memory management strategies for memory allocations and implementation of virtual	Analyze	L4
CO5	Understand I/O management, disc management, and file system structure.	Understand	L2
CO6	Understand I/O management, disc management, and file system structure.	Understand	L2

7. **Mapping of course outcomes to module / course content**

Module	CO1	CO2	CO3	CO4	CO5	CO6

8. **Mapping of the Course outcomes to Program Outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												
AVG.												

9. **Mapping to PSO**

	PSO1	PSO2	PSO3	PSO4
CO1				
CO2				
CO3				
CO4				
CO5				
CO6				

***** End of Syllabus*** < HM CS701 >**

Course Name: Neural Networks & Deep Learning
Course Code: CS703
(Semester-VII)
Category: Major
Course Broad Category: Engineering Science Course
[For Computer Science and Engineering]

1. **Course Prerequisite:**
   - Linear Algebra, Probability and Statistics, Calculus,
   - Machine Learning Basics,
   - Programming (Python and Libraries like NumPy, TensorFlow, PyTorch)

2. **Course Learning Objectives:**
   By the end of this course, students will be able to:
   i. Explain learning paradigms, deep learning frameworks, and fundamental techniques.
   ii. Design and implement artificial neural networks with activation functions and multi-layer structures.
   iii. Train and optimize neural networks using loss functions, backpropagation, and regularization.
   iv. Apply probabilistic models such as CRFs, Markov Networks, and HMMs in deep learning.
   v. Develop and deploy deep learning models for computer vision, NLP, and object recognition.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.

4. **Course Content:**
   Course Name: Neural Networks and Deep Learning
   Course Code: CS703
   Hours per Week: 3L:0T:0P
   Credits: 3

Module	Topics	Lectures
Unit 1: Introduction:	Various paradigms of earning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques..	3L
Unit 2: Feed forward neural network:	Artificial Neural Network, activation function, multi-layer neural network. cardinality, operations, and properties of fuzzy relations.	6L
Unit 3: Training Neural Network:	Risk minimization, loss function, backpropagation, regularization, model selection, and optimization.	6L
Unit 4: Conditional Random Fields:	Linear chain, partition function, Markov network, Belief propagation, Training CRFs, Hidden Markov Model, Entropy.	9L
Unit 5: Deep Learning:	Deep Feed Forward network, regularizations, training deep models, dropouts, Convolutional Neural Network, Recurrent Neural Network, Deep Belief Network.	6L
Unit 6: Deep Learning research: Programming	Object recognition, sparse coding, computer vision, natural language	6L

5. **References:**
   Text & References Books:
   - Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.
   - Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.

- Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
- Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.
- Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.
- Dr. Rajiv Chopra, Deep Learning, Khanna Publishing House, New Delhi (AICTE Recommended Textbook – 2018)

6. Course Outcomes:

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CS703.CO1	Describe various learning paradigms, deep learning frameworks, and fundamental techniques.	Describe	Remember (L1)
CS703.CO2	Explain the structure of artificial neural networks, activation functions, and fuzzy relations.	Explain	Understand (L2)
CS703.CO3	Apply training techniques such as backpropagation, risk minimization, and optimization in neural networks.	Apply	Apply (L3)
CS703.CO4	Analyze probabilistic models like Conditional Random Fields (CRFs), Markov Networks, and Hidden Markov Models (HMMs).	Analyze	Analyze (L4)
CS703.CO5	Evaluate deep learning architectures including CNNs, RNNs, and Deep Belief Networks for various applications.	Evaluate	Evaluate (L5)
CS703.CO6	Design and implement deep learning models for real-world applications in vision, NLP, and object recognition.	Design	Create (L6)

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	Yes	Yes	-	-	-	-
2	-	Yes	Yes	-	-	-
3	-	-	Yes	-	Yes	-
4	-	-	-	Yes	Yes	-
5	-	-	-	-	Yes	Yes
6	-	-	-	-	-	Yes

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	1	2	-	1	1	2	1	3
CO2	3	2	1	1	2	-	1	1	2	1	3
CO3	3	3	2	2	3	-	1	2	2	2	3
CO4	3	3	2	3	3	1	1	2	2	2	3
CO5	3	3	3	3	3	1	1	2	3	2	3
CO6	3	3	3	3	3	1	1	2	3	3	3
AVG.	**3**	**2.67**	**2**	**2.17**	**2.27**	**0.5**	**1**	**1.67**	**2.33**	**1.83**	**3**

9. Mapping to PSO

Course Outcome	PSO1	PSO2	PSO3
CS703.CO1	2	1	2
CS703.CO2	2	1	1
CS703.CO3	3	2	2
CS703.CO4	3	1	2
CS703.CO5	3	2	3
CS703.CO6	3	3	3

***** End of Syllabus *** < CS703>**

Course Name: Natural Language Processing
Code: CS704
(Semester –VII)
Category: Core Elective IV
Course Broad Category: Professional Elective Course
[For Computer Science and Engineering]

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1. **Course Prerequisite:**
   Machine Learning

2. **Course Learning Objectives:**
   1. Be able to understand core concepts of modern NLP and limitations of traditional models
   2. Be able to apply transformer-based models to standard NLP tasks
   3. Be able to fine-tune pre-trained language models for downstream applications
   4. Be able to use Large Language Models through effective prompting and system design
   5. Be able to analyze performance, limitations, and ethical aspects of LLM-based systems

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions, and Case Studies.
   Evaluation System –
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.
4. **Course Content:**
   Course Name: Natural Language Processing
   Course Code: CS704
   Hours per Week: 3L:0T:0P

   Credits: 3

Module	Topics	Lectures
Unit 1: Foundations of Natural Language Processing	NLP pipeline overview, text preprocessing, tokenization, Bag-of-Words, TF-IDF, n-grams, language modeling concepts, evaluation metrics in NLP	7L
Unit 2: Neural NLP Models	Word embeddings (Word2Vec, GloVe – overview), limitations of classical and RNN-based models, Information Extraction, Knowledge Graph, Overview of Question Answering	8L
Unit 3: Transformers and Pre-trained Language Models	Transformer architecture overview, self-attention, positional encoding, encoder and decoder structures, pre-training vs fine-tuning, masked and causal language modeling, overview of BERT and related models	9L

Unit 4: Large Language Models (LLMs)	Concept of large-scale language models, decoder-only architecture (conceptual), instruction tuning, prompting techniques (zero-shot, few-shot, basic Chain-of-Thought, etc), overview of GPT and open LLMs, Fine-tuning LLM	9L
Unit 5: Retrieval-Augmented and Agentic NLP Systems	Motivation for retrieval-augmented generation (RAG), Graph RAG, basic RAG pipeline, vector embeddings (conceptual), introduction to agentic AI, tool-augmented LLMs, applications in chatbots, document QA, and research assistants	9L

6. References:

Text & References Books:

- Speech and Language Processing, Jurafsky and Martin, Pearson Education
- Foundation of Statistical Natural Language Processing, Manning and Schutze, MIT Press.
- Multilingual Natural Language Processing Applications from Theory to Practice: Bikel, Pearson.
- Tanmoy Chakraborty, Introduction to Large Language Models Generative AI for Text, Wiley.
- I. Goodfellow, Y. Bengio, and A. Courville, Deep Learning, The MIT Press.

7. Course Outcomes:

This course aims to provide a comprehensive background in Natural Language Processing.

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CS704.1	Understand core concepts of modern NLP and limitations of traditional models	Understand	K2
CS704.2	Apply transformer-based models to standard NLP tasks	Apply, Evaluate	K3, K5
CS704.3	Fine-tune pre-trained language models for downstream applications	Apply, Analyze	K3, K4
CS704.4	Use Large Language Models through effective prompting and system design	Apply, Develop	K3, K6
CS704.5	Design simple retrieval-augmented and agent-based NLP systems	Analyze, Develop	K4, K6
CS704.6	Analyze performance, limitations, and ethical aspects of LLM-based systems	Evaluate, Develop	K5, K6

8. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	–	–	–	–	–
2	2	2	–	–	1	–
3	1	3	3	–	–	2
4	–	–	2	3	–	3
5	–	–	–	2	3	3

9. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	-	-	-	-	-	-	-	-
CO2	3	3	3	2	2	1	-	-	-	-	-
CO3	2	3	3	3	3	2	-	-	-	-	-
CO4	1	2	3	3	3	3	1	1	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	-
AVG	**2.25**	**2.5**	**2.5**	**2.66**	**2.66**	**2**	**1**	**1**	**0**	**0**	**0**

10. Mapping to PSO

Course Outcome	PSO1	PSO2	PSO3
CS704.CO1	2	1	1
CS704.CO2	3	2	2
CS704.CO3	3	3	2
CS704.CO4	3	3	3
CS704.CO5	-	-	-
CS704.CO6	-	-	-

***** End of Syllabus***<CS704>**

Course Name: Mobile Computing
Course Code: CS705
(Semester-VII)
Category: Major
Course Broad Category: Engineering Science Course
[For Computer Science and Engineering]

1. **Course Prerequisite:**
   The study of the basic principles of analog and digital communication, including modulation, transmission, and reception, is referred to as "basic communication systems." Computer networks: the basics of networking, such as network protocols, routing, switching, and the OSI and TCP/IP models. Basics of Wireless Communication: Introduction to frequency spectrum, signal propagation, and wireless communication. Principles of Mobile Computing: A review of wireless technology, mobility management, and mobile devices. The basics of signal processing techniques applied in wireless communication are discussed in Digital Signal Processing (DSP). Web programming and technologies: Understanding web technologies like HTML, basic scripting, and network protocols is required in order to understand mobile web applications.

2. **Course Learning Objectives:**
   i. Understand mobile communications systems by explaining the network signalling, mobility control, and topology of GSM, GPRS, and PCS networks.
   ii. Discuss wireless networking technologies incorporating mobile IP, WLAN (IEEE 802.11), wireless protocols employed during mobile data transportation.
   iii. Discuss wireless protocols and the standards of the mobile internet. Describe wireless mark-up languages, WAP, WAP Gateway, and what role they play in mobile web applications.
   iv. Identify 3G networks and wireless local loops (WLL) With focus on Quality of Service (QoS), discuss the WLL architecture, technologies, and key features of IMT-2000, W-CDMA, and CDMA 2000.
   v. Evaluate Satellite-Based Mobile Communication Systems: To understand satellite-based communication networks, study case studies of IRIDIUM and GLOBALSTAR systems.
   vi. Study Pervasive Computing and Wireless Enterprise Networks. Learn about Bluetooth protocols, virtual networks, and ubiquitous web application development using device-independent applications.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.

4. **Course Content:**
   Course Name: Mobile Computing
   Course Code: CS705
   Hours per Week: 3L:0T:0P
   Credits: 3

Module	Topics	Lectures
Unit 1: Introduction to Personal Communications Services (PCS)	PCS Architecture, Mobility management, Networks signalling. Global System for Mobile Communication (GSM) system overview: GSM Architecture, Mobility management, Network signalling.	5L
Unit 2: General Packet Radio Services (GPRS)	GPRS Architecture, GPRS Network Nodes. Mobile Data Communication: WLANs (Wireless LANs) IEEE 802.11 standard, Mobile IP.	5L
Unit 3:Wireless Application Protocol (WAP)	The Mobile Internet standard, WAP Gateway and Protocols, wireless markup Languages (WML). Wireless Local Loop(WLL): Introduction to WLL Architecture, wireless Local Loop Technologies.	7L

Unit 4: Third Generation (3G) Mobile Services	Introduction to International Mobile Telecommunications 2000 (IMT 2000) vision, Wideband Code Division Multiple Access (W-CDMA), and CDMA 2000, Quality of services in 3G	L
Unit 5: Global Mobile Satellite Systems	case studies of the IRIDIUM and GLOBALSTAR systems. Wireless Enterprise Networks: Introduction to Virtual Networks, Bluetooth technology, Bluetooth Protocols.	7L
Unit 6: Server-side programming in Java	Pervasive web application architecture, Device independent example application.	8L

5. References:

Text & References Books:

- "Pervasive Computing", Burkhardt, Pearson
- "Mobile Communication", J. Schiller, Pearson
- "Wireless and Mobile Networks Architectures", Yi-Bing Lin & Imrich Chlamtac, John Wiley & Sons, 2001
- "Mobile and Personal Communication systems and services", Raj Pandya, Prentice Hall of India, 2001.
- "Guide to Designing and Implementing wireless LANs", Mark Ciampa, Thomson learning, Vikas Publishing House, 2001.
- "Wireless Web Development", Ray Rischpater, Springer Publishing,
- "The Wireless Application Protocol", Sandeep Singhal, Pearson .
- "Third Generation Mobile Telecommunication systems", by P. Stavronlakis, Springer Publishers
- Brijesh Gupta “Mobile Computing”, Khanna Publishing House, New Delhi

6. Course Outcomes:

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CS705.CO1	Explain the architecture, mobility management, and network signaling of Global System for Mobile Communication's (GSM) and Personal Communication Systems' (PCS).	Explain	L2
CS705.CO2	Define the General Packet Radio Service (GPRS) network nodes and architecture. Evaluate mobile data transmission technologies such as Mobile IP and WLAN (IEEE 802.11).	Define	L2
CS705.CO3	Describe the Wireless Markup Language (WML), WAP Gateway, WAP protocols, and Mobile Internet standard for mobile web applications.	Describe	L2
CS705.CO4	Discuss Wireless Local Loops (WLLs) architecture and technology, and a summary of IMT-2000, W-CDMA, and CDMA 2000, with an emphasis on Quality of Service (QoS) in 3G networks.	Discuss	L2
CS705.CO5	Discuss case studies of satellite communication systems, such as GLOBALSTAR and IRIDIUM, to understand their applications and architecture.	Discuss	L2
CS705.CO6	Discuss Bluetooth technologies and protocols, virtual networks, and web application architecture through examples of device-independent applications.	Discuss	L2

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1						
2						
3						
4						
5						
6						
7						

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	2				2		1
CO2	3	3	3	2	3				2	2	2
CO3	3	2	2	3	3				2	1	2
CO4	3	3	3	3	3	2			3	2	2
CO5	3	3	2	3	2	2			2	1	1
CO6	3	3	2	3	3	2			3	2	2
AVG.	**3**	**2.83**	**2.33**	**2.67**	**2.67**	**1**	**0**	**0**	**2.33**	**1.33**	**1.67**

9. Mapping to PSO

Course Outcome	PSO1	PSO2	PSO3
CS705.CO1	2	1	1
CS705.CO2	2	1	2
CS705.CO3	2	2	2
CS705.CO4	2	1	2
CS705.CO5	2	1	2
CS705.CO6	2	3	3

***** End of Syllabus*** < CS705>**

Course Name: Cyber Security
Course Code: CS713
(Semester-VII)
Category: Major
Course Broad Category: Engineering Science Course
[For Computer Science and Engineering]

1. **Course Prerequisite:**

   - Basic understanding of computer networks and operating systems.
   - Familiarity with internet protocols and basic programming concepts.
   - Fundamental knowledge of information security.

2. **Course Learning Objectives:**

   I. Analyze hacking techniques, ethical hacking, and social engineering defenses.
   II. Understand core cyber security concepts, threats, and protective measures.
   III. Apply cyber forensics processes and auditing standards like ISO 27001.
   IV. Evaluate cyber laws, ethics, and their implications in digital environments.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.

4. **Course Content:**
   Course Name: Cyber Security
   Course Code: CS713
   Hours per Week: 3L:0T:0P
   Credits: 3

Module	Topics	Lectures
Unit 1: Introduction	Introduction to Cyber Security, Importance and challenges in Cyber Security, Cyberspace, Cyber threats, Cyber warfare, CIA Triad, Cyber Terrorism, Cyber Security of Critical Infrastructure, Cyber security - Organizational Implications..	6L
Unit 2: Hackers and Cyber Crimes	Types of Hackers, Hackers and Crackers, Cyber-Attacks and Vulnerabilities, Malware threats, Sniffing, Gaining Access, Escalating Privileges, Executing Applications, Hiding Files, Covering Tracks, Worms, Trojans, Viruses, Backdoors.	7L
Unit 3: Ethical Hacking and Social Engineering	Ethical Hacking Concepts and Scopes, Threats and Attack Vectors, Information Assurance, Threat Modelling , Enterprise Information Security Architecture, Vulnerability Assessment and Penetration Testing, Types of Social Engineering, Insider Attack, Preventing Insider Threats, Social Engineering Targets and Defence Strategies.	8L
Unit 4: Cyber Forensics and Auditing	Introduction to Cyber Forensics, Computer Equipment and associated storage media, Role of forensics Investigator, Forensics Investigation Process, Collecting Network based Evidence, Writing Computer Forensics Reports, Auditing, Plan an audit against a set of audit criteria, Information Security Management System Management. Introduction to ISO 27001:2013	10L
Unit 5: Cyber Ethics and Laws	Introduction to Cyber Laws, E-Commerce and E-Governance, Certifying Authority and Controller, Offences under IT Act, Computer Offences and its penalty under IT Act 2000, Intellectual Property Rights in Cyberspace. at Network Layer-IPSec..	5L

5. **References:**

   Text & References Books:

   - Cyber security, Nina Gobole & Sunit Belapune; Pub: Wiley India.

- Information Security and Cyber Laws, Pankaj Agarwal
- Donaldson, S., Siegel, S., Williams, C.K., Aslam, A., Enterprise Cybersecurity -How to Build a Successful Cyber defense Program Against Advanced Threats, A-press
- Nina Godbole , Sumit Belapure, Cyber Security, Willey
- Hacking the Hacker, Roger Grimes, Wiley
- Cyber Law By Bare Act, Govt Of india, It Act 2000.
- Information Security & Cyber Laws, Gupta & Gupta, Khanna Publishing House, (AICTE Recommended Textbook- 2018)

6. Course Outcomes:

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CS713.CO1			
CS713.CO2			
CS713.CO3			
CS713.CO4			
CS713.CO5			
CS713.CO6			

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1						
2						
3						
4						
5						
6						
7						

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												
AVG.												

9. Mapping to PSO

	PSO1	PSO2	PSO3	PSO4
CO1	-	-	-	-
CO2	-	-	-	-
CO3	-	-	-	-
CO4	-	-	-	-
CO5	-	-	-	-
CO6	-	-	-	-

***** End of Syllabus*** < CS713>**

Course Name: Quantum Computing
Course Code: CS714
(Semester-VII)
Category: Major
Course Broad Category: Engineering Science Course
[For Computer Science and Engineering]

1. **Course Prerequisite:**

2. **Course Learning Objectives:**

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.

4. **Course Content:**
   Course Name: Quantum Computing
   Course Code: CS714
   Hours per Week: 3L:0T:0P
   Credits: 3

Module	Topics	Lectures
Unit 1:	Qubit & Quantum States: The Qubit, Vector Spaces. Linear Combination Of Vectors, Uniqueness of a spanning set, basis & dimensions, inner Products, orthonormality, gram-schmidt orthogonalization, bra-ket formalism, the Cauchyschwarez and triangle Inequalities..	3L
Unit 2:	Matrices & Operators: Observables, The Pauli Operators, Outer Products, The Closure Relation, Representation of operators using matrices, outer products & matrix representation, matrix representation of operators in two dimensional spaces, Pauli Matrix, Hermitian unitary and normal operator, Eigen values & Eigen Vectors, Spectral Decomposition, Trace of an operator, important properties of Trace, Expectation Value of Operator, Projection Operator, Positive Operators	10L
Unit 3:	Commutator Algebra, Heisenberg uncertainty principle, polar decomposition &singular values, Postulates of Quantum Mechanics.	5L
Unit 4:	Tensor Products: Representing Composite States in Quantum Mechanics, Computing inner products, Tensor products of 5 column vectors, operators and tensor products of Matrices. Density Operator: Density Operator of Pure & Mix state, Key Properties, Characterizing Mixed State, Practical Trace & Reduce Density Operator, Density Operator & Bloch Vector.	5L
Unit 5:	Quantum Measurement Theory: Distinguishing Quantum states & Measures, Projective Measurements, Measurement on Composite systems, Generalized Measurements, Positive Operator- Valued Measures	8L
Unit 6:	Recent trends in Quantum Computing Research, Quantum Computing Applications of Genetic Programming..	6L

5. **References:**

   Text & References Books:
   - Quantum Computing without Magic by Zdzislaw Meglicki
   - Quantum Computing Explained By DAVID Mc MAHON
   - Quantum Computer Science By Marco Lanzagorta, Jeffrey Uhlmann

- An Introduction to Quantum Computing Phillip Kaye, Raymond Laflamme, Michele Mosca.

6. Course Outcomes:

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CS714.CO1			
CS714.CO2			
CS714.CO3			
CS714.CO4			
CS714.CO5			
CS714.CO6			

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1						
2						
3						
4						
5						
6						
7						

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												
AVG.												

9. Mapping to PSO

	PSO1	PSO2	PSO3	PSO4
CO1	-	-	-	-
CO2	-	-	-	-
CO3	-	-	-	-
CO4	-	-	-	-
CO5	-	-	-	-
CO6	-	-	-	-

***** End of Syllabus*** < CS714>**

Course Name: High Performance Computing
Course Code: CS715
(Semester- VII)
Category: Major
Course Broad Category: Professional Elective Course
[For Computer Science and Engineering]

1. **Course Prerequisite:**
   - Computer Organization and Architecture
   - Operating System
   - Data Structure and Algorithms.

2. **Course Learning Objectives:**
   i. To introduce fundamental concepts of High Performance Computing (HPC).
   ii. To familiarize students with parallel architectures, shared-memory and distributed-memory models.
   iii. To explain performance concepts such as speedup, scalability, and bottlenecks.
   iv. To provide exposure to HPC tools, ecosystems, and real-world applications.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions, and Case Studies.
   Evaluation System –
   D. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   E. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   F. End-Semester Exam (60 Marks)- Summative Assessment.

4. **Course Content**
   Course Name: High Performance Computing
   Course Code: CS715
   Hours per Week: 3L
   Credits: 3

Module	Topics	Lectures
Unit 1	Introduction to High Performance Computing: Need for HPC, advantages and limitations, Applications in AI scientific simulations, finance, healthcare, CPU vs GPU vs Cluster vs Supercomputer (introductory comparison), Concepts of parallelism: task-level, data-level Flynn's Taxonomy: SISD, SIMD, MISD, MIMD, Basic architecture components: processors, memory, interconnects	10
Unit 2	Parallel Programming Fundamentals: Shared vs distributed memory programming, Processes, threads, concurrency, Performance metrics (Execution time, Speedup, Efficiency, Scalability), Amdahl's Law & Gustafson's Law (intuitive explanation), Bottlenecks in parallel programs, Load balancing, communication overhead	10
Unit 3	Introduction to GPU Computing: What is a GPU, CPU vs GPU architecture (basic ideas) Introduction to CUDA programming model (concepts only), Kernels, threads, blocks, Applications in ML training, graphics, simulations	8
Unit 4	Shared Memory Concepts: Shared vs. Distributed Memory Models, Shared Memory Architecture: UMA & NUMA, Memory Hierarchy & Communication through Shared Memory, Cache Coherence (basics) & Consistency Concepts, Synchronization Issues: Race Conditions, Mutual Exclusion, Deadlock (concept only)	8

5. **References:**
   Text & References Books:

- Introduction to Parallel Computing, Grama, Gupta, Karypis, Kumar – Pearson
- Parallel Programming with MPI, Peter Pacheco – Morgan Kaufmann.
- Advanced Computer Architecture: Parallelism, Scalability, Programmability, Kai Hwang -- McGraw Hill.

- Parallel Computing: Theory and Practice, Michael J. Quinn-- Tata McGraw Hill (Indian Edition)

6. Course Outcomes:

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CS715.CO1	Understand the necessity, evolution, classifications, and design issues of high-performance computing systems.	Understand	L2
CS715.CO2	Apply fundamentals of parallel programming models including shared memory, distributed memory, and performance metrics.	Apply	L3
CS715.CO3	Identify challenges associated with concurrency, coherence, synchronization, and memory consistency in parallel systems.	Identify	L1
CS715.CO4	Analyze GPU and multicore architectures to evaluate performance and scalability.	Analyze	L4
CS715.CO5	Understand HPC tools, ecosystems, and applications across scientific and engineering domains.	Understand	L2
CS715.CO6	Understand the role of job scheduling, parallel libraries, and HPC runtime environments.	Understand	L2

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	-	3	3	-
4	-	3	-	-	-	3

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	1	1						
CO2	2	3	3	2	1						
CO3	2	3	3	3	1						
CO4	1	2	3	3	2						
CO5	2	2	2	2	3						
CO6	1	2	2	3	3						
AVG.	**1.83**	**2.33**	**2.33**	**2.33**	**1.83**						

9. Mapping to PSO

	PSO1	PSO2	PSO3
CO1			
CO2			
CO3			
CO4			
CO5			
CO6			

***** End of Syllabus***<CS715>**

Course Name: Cloud Computing
Code: CS716
(Semester –VII)
Category: Major
Course Broad Category: Professional Elective Course
[For Computer Science and Engineering]

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1. **Course Prerequisite:**
   Operating System
   Basic Computer Fundamentals
   Computer Networking Concepts- PCC-CS602
   Operating Systems PCC-CS 502

2. **Course Learning Objectives:**
   - Understand the **concept, characteristics, and benefits** of cloud computing.
   - Differentiate between **IaaS, PaaS, and SaaS** service models.
   - Compare **deployment models**: Public, Private, Hybrid, and Multi-cloud.
   - Recognize the **economic benefits** of cloud: CAPEX vs OPEX.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology –Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.

4. **Course Content:**
   Course Name: Cloud Computing
   Course Code: CS702
   Hours per Week: 3L:0T:0P
   Credits: 3

Module	Topics	Lectures
Unit 1: Definition of Cloud Computing and its Basics (Lectures).	Defining a Cloud, Cloud Types – NIST model, Cloud Cube model, Deployment models (Public , Private, Hybrid and Community Clouds), Service Platform as a Service, Software as a Service with examples of services/ service providers, models – Infrastructure as a Service, Cloud Reference model, Characteristics of Cloud Computing – a shift in paradigm Benefits and advantages of Cloud Computing, A brief introduction on Composability, Infrastructure, Platforms, Virtual Appliances, Communication Protocols, Applications, Connecting to the Cloud by Clients, IaaS – Basic concept, Workload, partitioning of virtual private server instances, Pods, aggregations, silos PaaS – Basic concept, tools and development environment with examples SaaS - Basic concept and characteristics, Open SaaS and SOA, examples of SaaS platform Identity as a Service (IDaaS) Compliance as a Service (CaaS)	9L

Unit 2: Use of Platforms in Cloud Computing	Concepts of Abstraction and Virtualization Virtualization technologies : Types of virtualization (access, application, CPU, storage), Mobility patterns (P2V, V2V, V2P, P2P, D2C, C2C, C2D, D2D) Load Balancing and Virtualization: Basic Concepts, Network resources for load balancing, Advanced load balancing (including Application Delivery Controller and Application Delivery Network), Mention of The Google Cloud as an example of use of load balancing Hypervisors: Virtual machine technology and types, VMware vSphere Machine Imaging (including mention of Open Virtualization Format – OVF) Porting of applications in the Cloud: The simple Cloud API and AppZero Virtual Application appliance, Concepts of Platform as a Service, Definition of services, Distinction between SaaS and PaaS (knowledge of Salesforce.com and Force.com), Application development Use of PaaS Application frameworks, Discussion of Google Applications Portfolio – Indexed search, Dark Web, Aggregation and disintermediation, Productivity applications and service, Adwords, Google Analytics, Google Translate, a brief discussion on Google Toolkit (including introduction of Google APIs in brief), major features of Google App Engine service., Discussion of Google Applications Portfolio – Indexed search, Dark Web, Aggregation and disintermediation, Productivity applications and service, Adwords, Google Analytics, Google Translate, a brief discussion on Google Toolkit (including introduction of Google APIs in brief), major features of Google App Engine service, Windows Azure platform: Microsoft's approach, architecture, and main elements, overview of Windows Azure AppFabric, Content Delivery Network, SQL Azure	12L
Unit 3: Cloud Infrastructure:	Cloud Management: An overview of the features of network management systems and a brief introduction of related products from large cloud vendors, Monitoring of an entire cloud computing deployment stack – an overview with mention of some products, Lifecycle management of cloud services (six stages of lifecycle). Concepts of Cloud Security: Cloud security concerns, Security boundary, Security service boundary Overview of security mapping Security of data: Brokered cloud storage access, Storage location and tenancy, encryption, and auditing and compliance Identity management (awareness of Identity protocol standards)	7L
Unit 4: Concepts of Services and Applications:	Service Oriented Architecture: Basic concepts of message-based transactions, Protocol stack for an SOA architecture, Event-driven SOA, Enterprise Service Bus, Service catalogs, Applications in the Cloud: Concepts of cloud transactions, functionality mapping, Application attributes, Cloud service attributes, System abstraction and Cloud Bursting, Applications and Cloud APIs Cloud-based Storage: Cloud storage definition – Manned and Unmanned Webmail Services: Cloud mail services including Google Gmail, Mail2Web, Windows Live Hotmail, Yahoo mail, concepts of Syndication services	8L

6. References:

Text & References Books:

7. Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd, 2013 2. Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, McGraw Hill Education (India) Private Limited, 2013 3. Cloud computing: A practical approach, Anthony T. Velte, Tata Mcgraw-Hill 4. Cloud Computing, Miller, Pearson 5. Building applications in cloud:Concept, Patterns and Projects, Moyer, Pearson 6. Cloud Computing – Second Edition by Dr. Kumar Saurabh, Wiley India

8. Course Outcomes:

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CS702.1	Understand the **concept, characteristics, and benefits** of cloud computing.	Remembering	L-1
CS702.2	Differentiate between **IaaS, PaaS, and SaaS** service models.	Understanding	L-2
CS702.3	Private ,Public and Hybrid clouds	Understanding	L-2
CS702.4	Recognize the **economic benefits** of cloud: CAPEX vs OPEX.	Analyzing	L-3
CS702.5	Practical implementation on clouds	Apply	L-4

9. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5
1	1	-	-	-	-
2	-	1	-	-	-
3	-	1	1	-	-
4				1	-
5	-	-	-	-	1
6	-	-	-	-	-
7	-	-	-	-	-

10. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1		-	1	1	-	-	-	1	-
CO2	1	1	1	1	-	-	-	-	-	-	-
CO3	-	1	1	1	-	-	-	-	-	1	-
CO4	-	-	1	1	1	-	-	-	-	1	-
CO5	-	-	-	1	-	-	-	-	-	-	-
CO6	-	-	-		1	-	-	-	-	1	-
AVG.	**1**	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**1**	**-**

11. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	-	-	-
CO2	-	-	-
CO3	-	-	-
CO4	-	-	-
CO5	-	-	-
CO6	-	-	-

***** End of Syllabus*****

Course Name: E-Commerce & ERP
Course Code: CS722
(Semester-VII)
Category: Major
Course Broad Category: Engineering Science Course
[For Computer Science and Engineering]

1. **Course Prerequisite:**

2. **Course Learning Objectives:**

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment

4. **Course Content:**
   Course Name: E-Commerce & ERP
   Course Code: CS722
   Hours per Week: 3L:0T:0P
   Credits: 3

Module	Topics	Lectures
Unit 1: Overview	Definitions, Advantages & Disadvantages of E – Commerce, Threats of E – Commerce, Managerial Prospective, Rules & Regulations For Controlling E – Commerce, Cyber Laws.	3L
Unit 2: Technologies	Relationship Between E – Commerce & Networking, Different Types of Networking Commerce, Internet, Intranet & Extranet, EDI Systems Wireless Application Protocol : Definition, Hand Held Devices, Mobility & Commerce, Mobile Computing, Wireless Web, Web Security, Infrastructure Requirement For E – Commerce .	5L
Unit 3: Business Models of e – commerce	Model Based On Transaction Type, Model Based On Transaction Party - B2B, B2C, C2B, C2C, E – Governance.	2L
Unit 4: E – strategy	Overview, Strategic Methods for developing E – commerce.	2L
Unit 5: Four C's	(Convergence, Collaborative Computing, Content Management & Call Center). Convergence: Technological Advances in Convergence – Types, Convergence and its implications, Convergence & Electronic Commerce. Collaborative Computing: Collaborative product development, contract as per CAD, Simultaneous Collaboration, Security. Content Management: Definition of content, Authoring Tools & Content Management, Content – partnership, repositories, convergence, providers, Web Traffic & Traffic Management; Content Marketing. Call Center : Definition, Need, Tasks Handled, Mode of Operation, Equipment , Strength & Weaknesses of Call Center, Customer Premises Equipment (CPE).	6L
Unit 6: Supply Chain Management	E – logistics, Supply Chain Portal, Supply Chain Planning Tools (SCP Tools), Supply Chain Execution (SCE), SCE - Framework, Internet's effect on Supply Chain Power.	3L

Unit 7: E – Payment Mechanism	Payment through card system, E – Cheque, E – Cash, E – Payment Threats & Protections.	1L
Unit 8: E – Marketing	Home –shopping, E-Marketing, Tele-marketing	1L
Unit 9: Electronic Data Interchange (EDI)	Meaning, Benefits, Concepts, Application, EDI Model, Protocols (UN EDI FACT / GTDI, ANSI X – 12), Data Encryption (DES / RSA).	2L
Unit 10: Risk of E – Commerce	Overview, Security for E – Commerce, Security Standards, Firewall, Cryptography, Key Management, Password Systems, Digital certificates, Digital signatures.	4L
Unit 11: Enterprise Resource Planning (ERP)	Features, capabilities and Overview of Commercial Software, re-engineering work processes for IT applications, Business Process Redesign, Knowledge engineering and data warehouse. Business Modules: Finance, Manufacturing (Production), Human Resources, Plant Maintenance, Materials Management, Quality Management, Sales &Distribution ERP Package, ERP Market: ERP Market Place, SAP AG, PeopleSoft, BAAN, JD Edwards, Oracle Corporation ERP-Present and Future: Enterprise Application Integration (EAI), ERP and E-Commerce, ERP and Internet, Future Directions in ERP	10L

5. References:

Text & References Books:

- E-Commerce ,M.M. Oka, EPH
- Kalakotia , Whinston : Frontiers of Electronic Commerce , Pearson Education.
- Bhaskar Bharat : Electronic Commerce - Technologies & Applications.TMH
- Loshin Pete, Murphy P.A. : Electronic Commerce , Jaico Publishing Housing.
- Murthy : E – Commerce , Himalaya Publishing.
- E – Commerce : Strategy Technologies & Applications, Tata McGraw Hill.
- Global E-Commerce, J. Christopher & T.H.K. Clerk, University Press
- Beginning E-Commerce, Reynolds, SPD
- Krishnamurthy, E-Commerce Mgmt, Vikas

6. Course Outcomes:

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CS722.CO1			
CS722.CO2			
CS722.CO3			
CS722.CO4			
CS722.CO5			
CS722.CO6			

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1						
2						
3						
4						
5						
6						
7						

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1											
CO2											
CO3											
CO4											
CO5											
CO6											
AVG.											

9. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	-	-	-
CO2	-	-	-
CO3	-	-	-
CO4	-	-	-
CO5	-	-	-
CO6	-	-	-

***** End of Syllabus*** < CS722>**

Course Name: Industrial Management
Course Code: OE CS723
(Semester- VII**)**
Category: Major
Course Broad Category: Engineering Science Course
[For Computer Science and Engineering]

1. **Course Prerequisite:**

2. **Course Learning Objectives:**
   i. To learn the concepts of Accounting and Recognize different systems used in industrial applications.
   ii. To learn the design of appropriate accounting tool required for real life problem.
   iii. To gain knowledge on Analyze and Simulate a sequential accounting tool for a system or process appropriate for required accuracy.
   iv. To learn to design a sequential economic policy that can work on required specification

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions, and Case Studies.
   Evaluation System –
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.

4. **Course Content**
   Course Name: Industrial Management
   Course Code: OE CS723
   Hours per Week: 3L
   Credits: 3

Module	Topics	Lectures
Unit 1	Systems and Management Fundamentals: System concept, definition, types, parameters, variables, and behavior. Management definition and core functions (planning, organizing, leading, controlling). Organization Structure: Definition and goals, Factors influencing structure formulation, Types of structures (e.g., functional, divisional, matrix), Advantages, disadvantages, and practical applications. Key Organizational Processes: Division of labor, scalar and functional processes, Span of control, delegation of authority, Centralization vs. decentralization in industrial management. Culture, Climate, and Employee Factors: Organizational culture and climate: meaning, differences, and influencing factors. Morale: factors affecting it and its relationship to productivity. Job satisfaction: influencing factors. Legal Framework: Important provisions of the Factory Act and key labor laws.	6
Unit 2	Fundamentals of CPM and PERT: Definitions, key features, differences, and practical applications. Network Diagram Construction and Analysis: Key terms in network diagrams (e.g., events, activities, and dummies), Drawing network diagrams for real-life projects (10-15 activities, minimum three examples), Computing earliest start/finish (ES/EF) and latest start/finish (LS/LF). Critical Path and Float Management: Identification of critical path, Types of floats (total, free, independent) and their calculation. Advanced Network Techniques: Network crashing, updating processes, and applications.	8
Unit 3	Materials Management Overview: Definition, core functions, importance, and	6

	interdepartmental relationships. Purchasing Processes: Objectives, systems, procedures, and standard terms/forms used. Storekeeping Operations: Functions, centralized vs. decentralized classification (advantages, disadvantages, applications). Store records, storage equipment types/applications, and codification methods. Inventory Control: Definition, objectives. Economic Order Quantity (EOQ) derivation and numeric examples. ABC analysis and modern inventory techniques. Inventory models (Wilson's, replenishment, two-bin): concepts and sketches. Material Requirement Planning (MRP): Concept, applications, and overview of market-available software packages.	
Unit 4	Production Planning and Control (PPC) Fundamentals, Types of production systems and practical examples. Need, importance, core functions, and key forms used. Production Scheduling Techniques: Meaning, need for productivity and resource utilization. Gantt chart: format, preparation methods, and applications. Critical ratio scheduling: methodology and numeric examples. Advanced Scheduling Applications: Gantt chart scheduling for 5-7 components (5-6 machining operations each, including processes, setup/operation times, resources, quantities; minimum two examples). Bottlenecking Management: Definition, effects on production, and strategies for reduction.	5
Unit 5	Value Analysis Fundamentals: Definition, key terms, systematic process, and strategic importance. Value Analysis Techniques: VA flow diagram and DARSIRI method. Case studies (minimum two real-world examples). Waste Management: Types of waste, common sources, and reduction strategies. Cost Control Practices: Methods for effective cost control and key guidelines.	4
Unit 6	Project Management Tools: Applications of MS Project, including key features for planning and tracking. Logistics Fundamentals: Concept, strategic need, and operational benefits. Just-in-Time (JIT): Core concept and primary benefits (e.g., waste reduction, efficiency gains). Supply Chain Management: Concept and key benefits (e.g., coordination, cost savings).	4

5. References:
Text & References Books:

6. Course Outcomes:
After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1			
CO2			
CO3			
CO4			
CO5			
CO6			

7. **Mapping of course outcomes to module / course content**

Module	CO1	CO2	CO3	CO4	CO5	CO6

8. **Mapping of the Course outcomes to Program Outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1											
CO2											
CO3											
CO4											
CO5											
CO6											
AVG.											

9. **Mapping to PSO**

	PSO1	PSO2	PSO3
CO1			
CO2			
CO3			
CO4			
CO5			
CO6			

***** End of Syllabus*****

Course Name: Game Theory & Applications
Course Code: OE CSE 724
(Semester- VII)
Category: Major
Course Broad Category: Open Elective
[For Computer Science and Engineering]

5. **Course Prerequisite:**
Concept of Mathematics in the previous semesters of B. Tech curriculum.

6. **Course Learning Objectives:**
   I. Provide a strong foundation in the principles of game theory and rational choice for analyzing strategic interactions among rational agents.
   II. Introduce cooperative and non-cooperative game-theoretic models and their fundamental solution concepts.
   III. Develop mathematical and computational skills required to analyze equilibrium existence, computation, and complexity in games.
   IV. Familiarize students with mechanism design frameworks, both with and without monetary incentives, including auctions, matching, and voting systems.
   V. Enable students to understand and evaluate real-world strategic and economic systems using game-theoretic tools.
   VI. Expose students to advanced and emerging applications of game theory, including digital markets, social networks, crowdsourcing, and interactions with machine learning.

7. **Teaching methodology and evaluation system for the course:**
Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures.

Evaluation System –
D. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
E. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
F. End-Semester Exam (60 Marks)- Summative Assessment.

8. **Course Content:**
Course Name: Game Theory & Applications
Course Code: OECSE 724
Hours per Week: 3L: 1T: 0P
Credits: 3

Module	Topics	34L
1.	**Introduction:** Making rational choices: basics of Games – strategy – preferences – payoffs – Mathematical basics –Game theory – Rational Choice – Basic solution concepts-non-cooperative versus cooperative games – Basic computational issues – finding equilibria and learning in games- Typical application areas for game theory (e.g. Google's sponsored search, eBay auctions, electricity trading markets).	5L

2.	**Cooperative Game Theory**: Correlated Strategies and Correlated Equilibrium, Two Person Bargaining Problem, Coalitional Games, The Core, and The Shapley Value.	5L
3.	**Non-Cooperative Game Theory:** Introduction to Game Theory, Extensive Form Games, Strategic Form Games, Dominant Strategy Equilibrium, Pure Strategy Nash Equilibrium, Mixed Strategy Nash Equilibrium, Sperner's Lemma, Fixed Point Theorem and Existence of Nash Equilibrium, Computation of Nash Equilibrium, Complexity of Computing Nash Equilibrium, Matrix Games (Two Players Zero Sum Games), Bayesian Games, Subgame Perfect Equilibrium.	8L
4.	**Mechanism Design without Money:** One sided and two-sided matching with strict preferences, Voting theory, and Participatory democracy. **Mechanism Design with Money:** Auction basics, sponsored search auctions, Revenue optimal auctions, VCG Mechanisms.	8L
5.	**Applications: Incentive Study in** - P2P Networks, Crowdsourcing, Digital currency, Social networks, Reputation Systems. **Some Special Topics -** Fair Division, Price of Anarchy, scoring rules, Hierarchy of equilibrium, Learning in Auction, Synergies between Machine Learning & Game Theory	8L

5. References:

Text Book:

- N. Nisan, T. Roughgarden, E. Tardos, and V. V. Vazirani. Algorithmic Game Theory. Cambridge University Press, New York, NY, USA, 2007, ISSN: 978- 0521872829.
- M. Maschler, E. Solan, and S. Zamir. Game Theory, Cambridge University Press; 1st Edition, ISSN: 978-1107005488, 2013.
- Y. Narahari. Game Theory and Mechanism Design. World Scientific Publishing Company Pte. Limited, 2014, ISSN: 978-9814525046
- T. Roughgarden, Twenty Lectures on Algorithmic Game Theory, Cambridge University Press, 2016, ISSN: 978-1316624791.

Reference Books:

- T. Roughgarden, CS364A: Algorithmic Game Theory Course (Stanford University), 2013.
- T. Roughgarden, CS269I: Incentives in Computer Science Course (Stanford University), 2016.
- S. Barman and Y. Narahari, E1:254 Game Theory Course (IISc Bangalore), 2012.
- Thomas S. Ferguson, Game TOTAL: 45 PERIODS Theory, Web notes available at (https://www.cs.cmu.edu/afs/cs/academic/class/15859s05/www/ferguson/comb.pdf)
- M. J. Osborne," An Introduction to Game Theory", Oxford University Press, 2012.
- M. Machler, E. Solan, S. Zamir, "Game Theory", Cambridge University Press, 2013.

6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Understand the fundamentals of rational decision-making, strategic interaction, and basic concepts of game theory including strategies, preferences, and payoffs.	Identify	Remember
CO2	Analyze and solve cooperative and non-cooperative games using appropriate solution concepts such as Nash equilibrium, correlated equilibrium, and bargaining solutions.	Explain	Understand
CO3	Apply mathematical tools such as fixed-point theorems and computational techniques to establish the existence and computation of equilibria in games.	Implement	Apply
CO4	Design and evaluate mechanisms with and without monetary transfers, including matching markets, voting systems, and auction mechanisms.	Organize	Analyze
CO5	Assess the computational complexity and algorithmic aspects of equilibrium computation in strategic and Bayesian games.	Assess	Evaluate
CO6	Apply game theory and mechanism design principles to real-world applications such as auctions, digital platforms, social networks, crowdsourcing, and peer-to-peer systems.	Construct	Create

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	2	-	-	-	1
2	3	3	-	-	-	1
3	2	1	3	2	2	1
4	2	1	3	3	1	1
5	2	1	2	2	3	1

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	1	1	2	-	-	-	-	-	-
CO2	1	2	3	1	-	-	-	-	-	-	-
CO3	1	2	2	1	1	-	-	-	-	-	-
CO4	1	2	1	1	2	-	-	-	-	-	-
CO5	2	2	2	2	3	-	-	-	-	-	-
CO6	1	1	1	1	-	-	-	-	-	-	-

9. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2	PSO3
CO1			
CO2			
CO3			
CO4			
CO5			
CO6			

Course Name: Bio-Informatics
Course Code: CS725
(Semester-VII)
Category: Major
Course Broad Category: Engineering Science Course
[For Computer Science and Engineering]

1. **Course Prerequisite:**
   - CS305 Biology

2. **Course Learning Objectives:**
   i. Explain core concepts of cell biology, molecular biology, and genetic information flow, including DNA/RNA structure, gene organization, and protein synthesis.
   ii. Apply bioinformatics tools, databases, and sequence analysis algorithms for exploring and interpreting biological data.
   iii. Use computational models and machine-learning techniques—such as HMMs, Bayesian networks, decision trees, and clustering—to analyze biological patterns and predict functional outcomes.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.

4. **Course Content:**
   Course Name: Bio-Informatics
   Course Code: CS725
   Hours per Week: 3L: 0T: 0P
   Credits: 3

Module	Topics	Lectures
Module 1:	Concepts of Cell, tissue, types of cell, components of cell, organelle. Functions of different organelles. Concepts of DNA: Basic Structure of DNA; Double Helix structure; Watson and Crick model. Exons and Introns and Gene Concept. Concepts of RNA: Basic structure, Difference between RNA and DNA. Types of RNA. Concept of Protein: Basic components and structure. Introduction to Central Dogma: Transcription and Translation, Introduction to Metabolic Pathways.	10
Module 2:	Introduction to Bioinformatics. Recent challenges in Bioinformatics. Protein Sequence Databases, DNA sequence databases. sequence database search programs like BLAST and FASTA. NCBI different modules: Gene Bank; OMIM, Taxonomy browser, PubMed;	7
Module 3:	DNA Mapping and Assembly: Size of Human DNA, Copying DNA: Polymerase Chain Reaction (PCR), Hybridization and Microarrays, Cutting DNA into Fragments, Sequencing Short DNA Molecules, Mapping Long DNA Molecules. DeBruijn Graph. Sequence Alignment: Introduction, local and global alignment, pairwise and multiple alignment, Dynamic Programming Concept. Alignment algorithms: Needleman and Wunsch algorithm, Smith-Waterman.	10
Module 4:	Probabilistic Models; Hidden Markov Model: Concepts, Architecture, Transition matrix, estimation matrix. Application of HMM in Bioinformatics: Gene finding, profile searches, multiple sequence alignment and regulatory site identification. Bayesian networks Model :Architecture, Principle ,Application in Bioinformatics.	6
Module 5:	Assigning protein function and predicting splice sites: Decision Tree Gene Expression Clustering. K Means Algorithm.	5

5. **References:**

   Text & References Books:
   - Vavid W. Mount: Bioinformatics:Sequenc and Genome analysis
   - Arther M. Leok: Introduction to Bioinformatics, Oxford

- Rastogiet.al.: Bioinformatics- Methods and applications-economics, Proteomics and Drug Discovery, Prentice Hall.
- Dan Gasfield: Algorithms on Strings, Trees and Sequences, Computer Science and Computational Biology, Cambridge University Press
- M. S. Waterman: Introduction to Computational Biology: Maps, Sequences and Genomes, 1995.
- Gibas, Jambeck: Developing Bio-informatics Computer Skills, SPD

6. Course Outcomes:

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CS725.CO1	Describe the fundamental concepts of cell biology, DNA/RNA structure, gene organization, and protein synthesis.	Describe	L2
CS725.CO2	Differentiate between various biomolecules and explain the central dogma and metabolic pathways.	Differentiate, Explain	L2
CS725.CO3	Utilize bioinformatics databases (NCBI, Gene Bank, OMIM) and perform sequence searches using BLAST and FASTA.	Utilize, Perform	L3
CS725.CO4	Implement sequence alignment techniques and analyze genome assembly methods using dynamic	Implement, Analyze	L4
CS725.CO5	Construct probabilistic models such as HMMs and Bayesian networks and evaluate their applications in gene finding and pattern recognition.	Construct, Evaluate	L5
CS725.CO6	Apply machine learning algorithms such as decision trees and K-means to interpret biological datasets and predict protein functions or splice sites.	Apply, Interpret, Predict	L5

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	3	-	-	-	-
2	-	-	3	-	-	-
3	-	-	-	3	-	-
4	-	-	-	-	3	-
5	-	-	-	-	-	3

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-
CO3	2	3	2	2	2	-	-	-	-	-	-
CO4	3	3	3	2	2	-	-	-	-	-	-
CO5	3	3	3	2	-	-	-	-	-	-	-
CO6	2	3	3	3	2	-	-	-	-	-	-
AVG.	**2.67**	**2.67**	**2.75**	**2.25**	**2**						

9. Mapping to PSO

	PSO1	PSO2	PSO3
CO1	-	-	-
CO2	-	-	-
CO3	-	-	-
CO4	-	-	-
CO5	-	-	-
CO6	-	-	-

***** End of Syllabus*** < CS725>**

Course Name: SOCIAL NETWORK ANALYSIS

Course Code: CS726

(Semester- VII**)**

Category: Open Elective III

Course Broad Category: Engineering Science Course

[For Computer Science and Engineering]

1. **Course Prerequisite:**
   - Graph theory
   - ML and R

2. **Course Learning Objectives:**
   i. To learn the Semantic Web.
   ii. To learn Ontology Engineering.
   iii. To learn Social Network Analysis and the Semantic Web
   iv. To learn Semantic Web Applications, Services and Technology
   v. To learn about visualisation and applications of social networks.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions, and Case Studies.
   Evaluation System –
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.

4. **Course Content**
   Course Name: Social Network Analysis
   Course Code: CS501
   Hours per Week: 3L
   Credits: 3

Module	Topics	Lectures
Unit 1	**Web Intelligence**: Thinking and Intelligent Web Applications, The Information Age, The World Wide Web, Limitations of Today's Web, The Next Generation Web, Machine Intelligence, Artificial Intelligence, Ontology, Inference engines, Software Agents, Berners-Lee www, Semantic Road Map, Logic on the Semantic Web.	3
Unit 2	**Knowledge Representation for the Semantic Web:** Ontologies and their role in the semantic web, Ontologies Languages for the Semantic Web – Resource Description Framework(RDF) / RDF Schema, Ontology Web Language(OWL), UML, XML/XML Schema.	10
Unit 3	**Ontology Engineering:** Ontology Engineering, Constructing Ontology, Ontology Development Tools, Ontology Methods, Ontology Sharing and Merging, Ontology Libraries and Ontology Mapping, Logic, Rule and Inference Engines.	5
Unit 4	**Semantic Web Applications, Services and Technology:** UNIT-IV: Semantic Web Applications, Services and Technology Semantic Web applications and services, Semantic Search, e-learning, Semantic Bioinformatics, Knowledge Base, XML-Based Web Services, Creating an OWL-S Ontology for Web Services, Semantic Search Technology, Web Search Agents and Semantic Methods	5
Unit 5	**Social Network Analysis and Semantic Web:** What is social Networks analysis, Development of Social Network Analysis, Electronic Sources for Network Analysis – Electronic Discussion networks, Blogs and Online Communities, Web-Based Networks. Building Semantic Web Applications with social network features.	8

5. References:

Text & References Books:

- Peter Mika, ―Social Networks and the Semantic Web, First Edition, Springer 2007.
- Berners Lee, Godel and Turing, ― Thinking on the Web, Wiley Interscience, 2008.
- Semantic Web Technologies, Trends and Research in Ontology-Based Systems, J.Davies, R.Studer, P.Warren, John Wiley & Sons.
- Semantic Web and Semantic Web Services -Liyang Lu Chapman and Hall/CRC Publishers,(Taylor & Francis Group)
- Borko Furht, ―Handbook of Social Network Technologies and Applications, 1st Edition, Springer, 2010.
- Guandong Xu ,Yanchun Zhang and Lin Li,-Web Mining and Social Networking – Techniques and applications, First Edition, Springer, 2011. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing

6. Course Outcomes:

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	To understand and knowledge representation for the semantic web	Understand	L2
CO2	To learn knowledge representation using ontology.	Apply	L3
CO3	To understand the basics of the Semantic Web and Social Networks.	Identify	L1
CO4	To learn visualization of social networks	Analyze	L4
CO5	To have access to a variety of descriptive measures for networks and software to calculate them, and have the ability to interpret the results.	Understand	L2

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	3	-	-	-
5	-	-	-	3	-	-

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1										3
CO2	2	3	3	1								3
CO3	3	3	3	2								3
CO4	2	3	3	2								3
CO5	2	3	3	2								3
AVG.	**2.4**	**2.6**	**3**	**1.75**								**3**

9. Mapping to PSO

	PSO1	PSO2	PSO3	PSO4
CO1	3	1	-	-
CO2	3	2	2	1
CO3	3	3	2	1
CO4	3	3	2	1
CO5	3	3	-	-

***** End of Syllabus*****

Course Name: Project II
Course Code: CS781
(Semester-VII)
Category: Major
Course Broad Category: Engineering Science Course
[For Computer Science and Engineering]

1. **Course Prerequisite:**
   - Fundamental knowledge on technical report writing
   - Understanding the basic components of research methodologies

2. **Course Learning Objectives:**
   i. Identify the gap in the present scenario on a research topic and create the scope to work
   ii. Students will come out with a working model and a detailed report. .

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.

4. **Course Content:**
   Course Name: Project II
   Course Code: CS781
   Hours per Week: 0L:0T:1P
   Credits: 6

Module	Topics	Lectures
Unit 1	Project Work I: The object of Project Work I is to enable the student to take up investigative study in the broad field of Computer Science and Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a supervisor. This is expected to provide a good initiation for the student(s) in R&D work	
Unit 2	Project Work II & Dissertation The object of Project Work II & Dissertation is to enable the student to extend further the investigative study taken up under EC P1, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include: 1. In depth study of the topic assigned in the light of the Report prepared under EC P1; 2. Review and finalization of the Approach to the Problem relating to the assigned topic; 3. Preparing an Action Plan for conducting the investigation, including team work; 4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed; 5. Final development of product/process, testing, results, conclusions and future directions; 6. Preparing a paper for Conference presentation/Publication in Journals, if possible; 7. Preparing a Dissertation in the standard format for being evaluated by the Department. 8. Final Seminar Presentation before a Departmental Committee.	

5. **References:**

   Text & References Books:

6. **Course Outcomes:**

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CS781.CO1	Conduct a survey on the work done in the chosen domain.	Evaluate	L5
CS781.CO2	Formulate the problem out of the survey.	Create	L6
CS781.CO3	Design some technique towards the solution of the problem defined.	Create	L6
CS781.CO4	Develop leadership capability and teamwork in collaborative environments.	Create	L6
CS781.CO5	Apply knowledge of the 'real world' situations that a professional engineer can encounter	Apply	L3

7. **Mapping of course outcomes to module / course content**

Module	CO1	CO2	CO3	CO4	CO5	CO6
1						
2						
3						
4						
5						
6						
7						

8. **Mapping of the Course outcomes to Program Outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	3	-	3	-	3	3	2	2	1	3
CO2	2	3	-	3	-	3	3	3	2	2	3
CO3	2	-	3	3	1	3	2	3	2	3	3
CO4	2	-	3	3	1	3	2	3	2	3	3
CO5	2	-	3	3	1	3	2	3	2	3	3
AVG.	**2**	**3**	**3**	**3**	**1**	**3**	**2.4**	**3**	**2**	**2.4**	**3**

9. **Mapping to PSO**

Course Outcome	PSO1	PSO2	PSO3
CS781.CO1	2	1	2
CS781.CO2	3	2	2
CS781.CO3	3	3	3
CS781.CO4	1	2	2
CS781.CO5	3	3	3

***** End of Syllabus*** < CS781>**