3rd Year 2ndSemester: 6thSemester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
				L	T	P	Total	
A. THEORY								
1	Humanities and Social Sciences including Management courses	HSMC 604	Economics for Engineers	2	0	0	2	2
2	Program Core Course	PCC-CS601	Computer Neteworks	3	0	0	3	3
3	Program Core Course	PCC-CS602	Software Engineering	3	0	0	3	3
4	Professional Elective courses	PEC-CS-T-601	Microprocessor and Microcontroller	3	0	0	3	3
		PEC-CS-S-601	Advanced Operating Systems					
		PEC-CS-D-601	Machine Learning					
		PEC-CS-A-601	Web and Internet Technology					
5	Professional Elective courses	PEC-CS-T-602	Parallel and Distributed Algorithms	3	0	0	3	3
		PEC-CS-S-602	Embedded Systems					
		PEC-CS-D-602	Soft Computing					
		PEC-CS-A-602	Human Computer Interaction					
6	Open Elective courses	OEC-CS-601A	Introduction to Internet of Things	3	0	0	3	3
		OEC-CS-601B	Bio-informatics					
		OEC-CS-601C	Robotics					
B. PRACTICAL								

7	Program Core Course	PCC-CS691	Computer Networks Lab	0	0	3	3	1.5
8	Program Core Course	PCC-CS692	Software Engineering Lab	0	0	3	3	1.5
9	Professional Elective courses	PEC-CS-T-691	Microprocessor and Microcontroller Lab	0	0	3	3	1.5
		PEC-CS-S-691	Advanced Operating Systems Lab					
		PEC-CS-D-691	Machine Learning Lab					
		PEC-CS-A-691	Web and Internet Technology Lab					
10	PROJECT	PR 691	Minor Project II	0	0	3	2	1
11	PROJECT	PR 692	Skill Development VI: Soft Skill & Aptitude-III	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
12	MC	MC 601	Intellectual Property Right	3	0	0	3	3Units
	TOTAL CREDIT WITHOUT MOOCS COURSES							23.0
D.MOOCS COURSES**								
13	MOOCS COURSES	HM601	MOOCS COURSE-IV	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**27**

Collective Data from 3rd to 6th Semester (Summer/Winter Training during Semester Break & Internship should be done after 5th Semester or 6th Semester). All related certificates to be collected by the training/internship coordinator(s).

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET**

Syllabus of 6th Semester

A.Theory

CourseName:EconomicsforEngineers
CourseCode:HSMC 604
Contact:2:0:0
Total Contact Hours: 24
Credits:2

Pre-requisites:
MATH–CollegeAlgebra,Pre-CalculusAlgebraandTrigonometry.

CourseOutcome(s):
CO1: Applytheappropriateengineeringeconomicsanalysismethod(s)forproblemsolving:presentworth,annualcost, rate-of-return,payback,break-even, benefit-costratio.
CO2: Evaluatethecosteffectivenessofindividualengineeringprojectsusingthemethodslearnedanddrawinferencesfortheinvestmentdecisions.
CO3: Comparethelifecyclecostofmultipleprojectsusingthemethodslearned,andmakeaquantitativedecisionbetweenalternatefacilitiesand/or systems.
CO4: Evaluatetheprofitofafirm,carryoutthebreakevenanalysisandemploythistooltomakeproductiondecision.
CO5: Discussandsolveadvancedeconomicengineeringanalysisproblemsincludingtaxationandinflation.

CourseContents:

Module1:Introduction[3L]
ManagerialEconomics-Relationshipwithotherdisciplines-Firms:Types,Objectivesandgoals-ManagerialDecisions-Decision Analysis.

Module2:**DemandandSupplyAnalysis**[5L]
Demand-Typesofdemand-determinantsofdemand-Demandfunction-DemandElasticity-Demandforecasting-Supply-Determinantsof supply-Supplyfunction-Supply Elasticity.

Module3:Cost Analysis[5L]
Elementof costs, Marginalcost,Marginal Revenue,Sunk cost,Opportunitycost,Break-evenanalysis –PVratio.

Module4:**ElementaryeconomicAnalysis[4L]**
Inflation-Meaningofinflation,types,causes,measurestocontrolinflation.
National Income-Definition,Conceptsofnationalincome,Methodofmeasuringnationalincome.

Module5:FinancialAccounting [5L]
ConceptsandDefinitionofAccounting,Journal,Ledger,TrialBalance.TradingA/C,Profit& Loss A/C and BalanceSheet.

Module6:InvestmentDecision[2L]
Time value of money-Interest- Simple and compound, nominal and effective rate of interest,Cashflow diagrams, Principles of economic equivalence. Evaluation of engineering projects-Present worthmethod, Future worth method, Annual worth method, Internal rate of return method, Cost benefitanalysis forpublicprojects.

Textbooks:

1. Riggs,BedworthandRandhwa,"EngineeringEconomics",McGrawHillEducationIndia
2. PrinciplesofEconomics,DevigaVengedasalam;KarunagaranMadhavan,OxfordUniversityPress.

ReferenceBooks:

1. EngineeringEconomybyWilliamG.Sullivan,ElinM.Wicks,C.PatricKoelling,Pearson
2. R.PaneerSeelvan,"EngineeringEconomics", PHI
3. Ahuja,H.L.,"PrinciplesofMicroEconomics",S.Chand&CompanyLtd
4. Jhingan,M.L.,"Macro EconomicTheory"
5. MacroEconomicsbyS.P.Gupta,TMH
6. Haniffand Mukherjee,Modern Accounting,Vol-1,TMG
7. ModernEconomicTheory –K.K.Dewett(S.Chand)

CO-POMAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	-	2	-
CO2	-	-	-	3	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	3	-
CO4	-	-	-	-	-	-	-	-	3	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	1	-

Course Name: Computer Networks
Course Code: PCC-CS601
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite:

1. Familiarity and knowledge of Operating Systems and Computer Architecture
2. Also require little bit programming languages concepts like C, Java.

Course Objective(s):

- To be familiar with the basics of data communication
- To be familiar with various types of computer networks
- To have experience in designing communication protocols
- To be exposed to the TCP/IP protocol suite

Course Outcome(s):

CO1: Understand OSI and TCP/IP models.
CO2: Analyze MAC layer protocols and LAN technologies.
CO3: Design applications using internet protocols.
CO4: Implement routing and congestion control algorithms.
CO5: Develop application layer protocols and understand socket programming

Course Contents:

Module 1: Introduction [6L]

Introduction (3L):
Introduction: Computer Network, data communication, topology, OSI & TCP/IP Reference Models, layers and characteristics, Wireless Network, comparison to wired and wireless network.
Physical Layer: [3L]
Overview of data (analog & digital), signal (analog & digital), transmission (analog & digital) & transmission media (guided & unguided); Circuit switching: time division & space division switch, TDM bus; Telephone Network;

Module 2: Data Link Layer [10L]

Framing, Error Control, Error Detection and Correction, Flow Control, Data Link Protocols, Simple Stop-and-Wait Protocol, ARQ mechanism, Sliding Window Protocols, One-Bit Sliding Window Protocol, Go-Back-N and Selective Repeat, HDLC, PPP Medium Access Control Sub-layer, The Channel Allocation. **[5L]**
Multiple Access Protocols**:** ALOHA, Carrier Sense Multiple Access Protocols, IEEE 802.x Ethernet, Switched Ethernet, Fast Ethernet, Gigabit Ethernet, 10 Gigabit Ethernet, Wireless LANs - IEEE 802.xx, Bluetooth, RFID, Bridges, Virtual LANs, Switching**. [5L]**

Module 3: Network Layer [10L]
IP Addressing, IPv4and IPv6. Difference IPv4and IPv6, Conversion ofIPv4and IPv6, Subnetting, Supernetting, Design Issues, Store-and-Forward Packet Switching, Virtual-Circuit and Datagram Networks, ARP, IP, ICMP, IPV6, BOOTP and DHCP–Delivery protocols Other Protocols such as mobile IP in wireless Network**. [5L]**
Routing: Shortest Path Algorithms, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing, Broadcast Routing, Multicast Routing, Anycast Routing: RIP, OSPF, BGP; Routing for Mobile Hosts**. [5L]**

Module 4: Transport layer: [6L]
Process to Process delivery; UDP; TCP, SCTP, TCP RENO, TCP/IP in Wireless environment, Congestion control in TCP: Congestion Control: Open Loop, Closed Loop choke packets; Quality of service: techniques to improve QoS: Leaky bucket algorithm, Token bucket algorithm. **[5L]**
Advanced topic such as Remote Procedure Call, Delay Tolerant Networks.**[1L]**

Module 5: Application Layer [3L]
Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW: Cryptography (Public, Private Key based), Digital Signature, Firewalls

Module 6: Socket Programming [1L]
Introduction to Socket Programming, UDP socket and TCP Socket

Text books:
1. B. A. Forouzan – "Data Communications and Networking (3rd Ed.) "– TMH
2. S. Tanenbaum – "Computer Networks (4th Ed.)" – Pearson Education/PHI
3. W. Stallings – "Data and Computer Communications (5th Ed.)" – PHI/ Pearson Education
4. Zheng & Akhtar, Network for Computer Scientists & Engineers, OUP

Reference books:

1. Kurose and Rose – "Computer Networking -A top-down approach featuring the internet" – Pearson Education

2. Leon, Garica,Widjaja – "Communication Networks" – TMH

3. Walrand – "Communication Networks" – TMH.

4. Comer – "Internetworking with TCP/IP, vol. 1, 2, 3(4th Ed.)" – Pearson Education/PHI

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		2	-	2	-	-	-	-	2	-	-	-
CO2		2	-	-	2	-	-	-	2	-	-	-
CO3	2	2	-	-	2	-	-	-	2	-	-	-
CO4	2	2	-	-	3	2	-	-	2	-	-	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-

Course Name: Software Engineering
Course Code: CS 602
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:
Programming for Problem Solving

Course Outcome(s):

CO1: To understand the basic concept of Software Engineering and mathematical knowledge and appthem in designing solution to engineering problem including he specification, design, implementation, and testing of software systems that meet specification, performance, maintenance and quality requirements

CO2: To analyze, elicit and specify software requirements through a productive working relationship with various stakeholders of the project

CO3: To design applicable solutions in one or more application domains using software engineering approaches that integrates ethical, social, legal and economic concerns.

CO4: To develop the code from the design and effectively apply relevant standards and perform testing, and quality management and practice team work.

CO5: Identify and Use modern engineering tools necessary for software project management time management and software reuse, and an ability to engage in life-long learning.

CourseContent:

Module-1:[6L]
Introduction: SoftwareEngineering, Characteristics,Components,Application,Definitions. Software Project Planning-Feasibility Analysis,TechnicalFeasibility, Cost-Benefit Analysis,Basics of estimation : COCOMO(Basic, intermediate, Complete) model.

Module- 2: [6L]
Evolution and impact of Software engineering, software life cycle models: Waterfall, prototyping, Evolutionary, and Spiral models. Feasibility study, Functional and Non-functional requirements, Requirements gathering, Requirements analysis and specification.

Module -3:[8L]
Basic issues in software design, modularity, cohesion, coupling and layering, function-oriented software design: DFD and Structure chart, object modeling using UML, Object-oriented software development, user interface design. Coding standards and Code review techniques.

Module -4:[7L]
Fundamentals of testing, White-box, and black-box testing, Test coverage analysis and test case design techniques, mutation testing, Static and dynamic analysis, Software reliability metrics, reliability growth modeling.

Module -5: [9L]
Software project management, Project planning and control, cost estimation, project scheduling using PERT and GANTT charts, cost-time relations: Rayleigh-Norden results, quality management, ISO and SEI CMMI, PSP and Six Sigma. Computer aided software engineering, software maintenance, software reuse, Component-based software development.

Text Books:
1. Fundamentals of Software Engineering by Rajib Mall, –PHI-3rd Edition, 2009.
2.SoftwareEngineering-PankajJalote(Wiley-India)

Reference Books:
1.SoftwareEngineering–AgarwalandAgarwal(PHI)
2.Software Engineering, by Ian Sommerville, Pearson Education Inc., New Delhi, (2009).
3. Software Engineering: A Practitioner‟s Approach", by Roger S. Pressman, McGraw-Hill.(2005)

CO–POMapping:

CO–PO&PSOMapping															
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3
CO2	3	3	2	2	-	-	-	-	-	-	-	-	3	2	3
CO3	3	3	3	3	-	-	-	3	-	-	-	3	3	3	2
CO4	3	3	3	3	-	-	-	-	3	-	-	-	3	3	3

CO5	3	2	3	2	3	-	-	-	3	2	3	3	3	2	2

Course Name: Microprocessors & Microcontrollers
Course Code: PEC-CS-T 601
Contact: 2:1:0
Total Contact Hours: 36
Credits: 3

Prerequisite:

1. Familiarity with the numbersystem
2. A solid background in digitallogic.

Course Objective(s):

- To learn the basics of a particularmicroprocessor.
- To learn the basics of a particularmicrocontroller.
- To learn the interfacing ofmicroprocessor.

Course Outcome(s):

CO1: To acquire the knowledge of hardware details of 8085 and 8086 microprocessor AND 8051 microcontroller with the related signals and their implications.
CO2: To develop skill in assembly Language programming of 8085
CO3: To understand the concept and techniques of designing and implementing interfacing of microprocessor with memory and peripheral chips involving system design.
CO4: To analyze the performance of computers and its architecture to real-life applications

Course Contents:

Module -1: [9L]
Introduction to Microcomputer based system. [1L]
History of evolution of Microprocessor and Microcontrollers and their advantages and disadvantages. [1L]
Architecture of 8085 Microprocessor, Pin description of 8085. [2L] Address/data bus De- multiplexing, Status Signals and the control signals. [1L]
Interrupts of 8085 processor (software and hardware) [2L]
I/O Device Interfacing - I/O Mapped I/O and Memory Mapped I/O, Memory interfacing with 8085 [2L]

Module -2: [9L]
Instruction set of 8085 microprocessor, Addressing modes. [3L]
Assembly language programming with examples, Counter and Time Delays, Stack and Subroutine. [4L]
Timing diagram of the instructions (a few examples) [2L]

Module 3: [7L]
The 8086 microprocessor- Architecture, Pin Details, Addressing modes, interrupts [3L] Instruction set, Examples of Simple Assembly Language [2L]
Memory interfacing with 8086 [2L]

Module -4: [6L]

Introduction to 8051 Microcontroller – Architecture, Pin Details. [3L]
Addressing modes, Instruction set, Examples of Simple Assembly Language. [3L]

Module -5: [5L]
Introduction, AVR Family architecture[1L],
Register File, The ALU[1L].
Memory access and Instruction execution.I/O memory.EEPROM. I/O ports[2].
Timers.UART. Interrupt Structure[1L]

Text Books:
1. MICROPROCESSOR architecture, programming and Application with 8085 - R. Gaonkar (Penram international Publishing LTD.) ***[For Module 1 and2]***
2. Fundamentals of Microprocessor and Microcontrollers - B. Ram (Paperback) ***[For Module3]***
3. 8051 Microcontroller – K. Ayala (Cengage learning) ***[For Module4]***

ReferenceBooks:
1. 8086 Microprocessor – K Ayala (Cengagelearning)
2. The 8051 microcontroller and Embedded systems - Mazidi, Mazidi and McKinley (PEARSON)

Course Name: Advanced Operating Systems
Course Code: PEC-CS-S-601
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Operating Systems

Course Outcome(s):
After completion of the course students will be able to
CO1 Demonstrate understanding of design issues of advanced operating systems and compare different types of operating systems.
CO2 Analyze the design aspects and issues of distributed operating systems.
CO3 Demonstrate understanding of different architectures used in Distributed Operating System.
CO4 Demonstrate understanding of different architectures used in Multiprocessor Operating System.
CO5 Formulate the solutions to schedule the real time applications.

Course Content:

Module 1:
Architectures of Distributed Systems: System Architecture Types, 1L
Distributed Operating Systems, Issues in Distributed Operating Systems, Communication Primitives.2L
Theoretical Foundations: Inherent Limitations of a Distributed System, 1L
Lamports Logical Clocks, Vector Clocks, Causal Ordering of Messages, Termination Detection.2L

Module 2:
Distributed Mutual Exclusion: The classification of Mutual Exclusion Algorithms 2L

Non-Token-Based Algorithms: Lamports Algorithm 1L
The Ricart-Agarwala Algorithm, Maekawas Algorithm, 1L
Token-Based Algorithms: Suzuki-Kasamis Broadcast Algorithm, 1L
Singhals Heuristics Algorithm, Raymonds Heuristric Algorithm. 2L

Module 3:
Distributed Deadlock Detection: Preliminaries, 1L
Deadlock Handling Strategies in Distributed Systems 1L
Issues in Deadlock Detection and Resolution, 1L
Control Organizations for Distributed Deadlock Detection, 1L
Centralized- Deadlock – Detection Algorithms, 1L
Distributed Deadlock Detection Algorithms, 1L
Hierarchical Deadlock Detection Algorithms 1L

Module 4:
Multiprocessor System Architectures: Introduction, Motivation for multiprocessor Systems, 1L
Basic Multiprocessor System Architectures 1L
Multi Processor Operating Systems: Introduction, Structures of Multiprocessor Operating Systems 1L
Operating Design Issues, Threads, Process Synchronization. 2L
Processor Scheduling 1L
Distributed File Systems: Architecture, Mechanisms for Building Distributed File Systems, Design Issues 2L

Module 5:
Distributed Scheduling : Issues in Load Distributing, Components of a load Distributed Algorithm, 2L
Stability, Load Distributing Algorithm, Requirements for Load Distributing, Task Migration, Issues in task migration. 2L
Distributed Shared Memory: Architecture and Motivation, Algorithms for Implementing DSM, 2L
Memory Coherence, Coherence Protocols, Design Issues 2L

Text book:
1. Mukesh Singhal and Niranjan Shivaratri, Advanced Concepts in Operating Systems, McGraw-Hill.
2. Andrew S. Tanenbaum, Distributed Operating Systems, ACM Press.

Reference Books:
1.Nancy Lynch, Distributed Algorithms, Morgan Kaufmann.
2.Jie Wu, Distributed Systems, CRC Press.
3.Hagit Attiya, Jennifer Welch, Distributed Computing: Fundamentals, Simulations and Advanced Topics, McGraw-Hill.
4.Sape Mullender (ed.), Distributed Systems, Addison-Wesley

CO–POMapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	-	-	-	-			
CO2	3	3	3	3	-	-	-	-	-	-	-	-			
CO3	3	3	3	3	-	-	-	-	-	-	-	3			
CO4	3	3	3	3	-	-	-	-	-	-	-	-			
CO5	3	3	3	3	-	-	-	-	3	2	-	-			

Name of the Paper: Machine Learning
Paper Code: PEC-CS-D-601
Contact (Periods/Week): 3L/Week
Credit Point: 3
No. of Lectures: 36

Prerequisite:
1. Basic programming skills, Algorithm design.
2. Probability, Axioms of Probability, Conditional Probability, Bernoulli Distribution, Binomial Distribution, Multinomial Distribution, Uniform Distribution, Normal (Gaussian) Distribution, Chi-Square Distribution, t Distribution, F Distribution. Probability Distribution and Density Functions, Joint Distribution and Density Functions, Conditional Distributions, Bayes' Rule, Expectation, Variance, Weak Law of Large Numbers.
3. Linear Algebra; Convex Optimization ; Statistics; Calculus.

Course Objective(s)
- To learn the concept of how to learn patterns and concepts from data without being explicitly programmed
- To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
- Explore supervised and unsupervised learning paradigms of machine learning.
- To explore Deep learning technique and various feature extraction strategies.

Course Outcome(s)
CO1: Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
CO2: Have an understanding of the strengths and weaknesses of many popular machine learning approaches.
CO3: Understand how to evaluate models generated from data.
CO4: Apply the algorithms to a real problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models

Module 1: [8L]

Supervised Learning (Regression/Classification) • Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes • Linear models: Linear Regression, Logistic Regression, Generalized Linear Models • Support Vector Machines, Nonlinearity and Kernel Methods • Beyond Binary Classification: Multi-class/Structured Outputs, Ranking

Module 2:[5L]

Unsupervised Learning • Clustering: K-means/Kernel K-means • Dimensionality Reduction: PCA and kernel PCA • Matrix Factorization and Matrix Completion • Generative Models (mixture models and latent factor models)

Module 3:[4L]

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)

Module 4: [7L]

Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning

Module 5: [7L]

Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference

Module6: [4L]

Recent trends in various learning techniques of machine learning and classification methods.

Text Book

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer

References:

1. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007
2. Dr. Rajiv Chopra, Machine Learning, Khanna Publishing House, 2018

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	3							2
CO2		3	3	2								1
CO3	2	3	3	3								1
CO4	2	2	3	3	2							

Name of the Paper: Web and Internet Technology
Paper Code: PEC-CS-A-601
Contact (Periods/Week): 3L/Week
Credit Point: 3
No. of Lectures: 36

Course Objective(s):

• To impart the design, development, and implementation of Static and Dynamic Web Pages.
• To develop programs for Web using Scripting Languages and .net framework.
• To give an overview of Server Side Programming in Web.

Course Outcome(s):

CO1 To understand the notions of World Wide Web(www), Internet, HTTP Protocol, Client-Server, etc.
CO2 To develop interactive web pages using HTML, DHTML,CSS and information interchange formats like XML
CO3To design web applications using scripting languages like JavaScript, CGI
CO4Toproduce the server-side programming concepts using servlet, JSP.
CO5 To acquire the knowledge on security related concept and web crawler

Course Contents:

Module 1: [6L]
Introduction (1L): Overview, Network of Networks, Intranet, Extranet, and Internet.
World Wide Web (1L): Domain and Sub domain, Address Resolution, DNS, Telnet, FTP, HTTP.
Review of TCP/IP (1L): Features, Segment, Three-Way Handshaking, Flow Control, Error Control, Congestion control, IP Datagram, IPv4 and IPv6.
IP Subnetting and addressing (1L): Classful and Classless Addressing, Subnetting. NAT, IP masquerading, IP tables.
Internet Routing Protocol (1L): Routing -Intra and Inter Domain Routing, Unicast and Multicast Routing, Broadcast.
Electronic Mail (1L): POP3, SMTP, Clients - Servers Communication.

Module -2: [9L]
HTML, DHTML &CSS : Introduction, Elements, Attributes, Heading, Paragraph. Formatting[1L]; Link, Table, List, Block, Layout, Html Forms, and input [1L]; Iframe, Colors[1L], Image Maps andattributes of image area [1L];
Introduction to CSS, basic syntax and structure of CSS, different typesinternal, external and inline CSS [1L];
Basic Introduction of DHTML, Difference between HTMLand DHTML, Documentary Object Model (DOM) [1L].
Extended Markup Language (XML) : Introduction, Difference between HTML & XML,XML-Tree [1L]; Syntax, Elements, Attributes, Validation and parsing, DTD [2L].

Module 3: [15L]
Java Scripts: Basic Introduction, Statements, comments, variable, operators, data types[1L];condition, switch, loop, break [1L]; Java script functions, objects, and events[1L].
CGI Scripts: Introduction, Environment Variable, GET and POST Methods[1L].
Java Servlet: Servlet environment and role, Servlet life cycle [1L]; Servlet methods- Request,Response, Get and post [1L]; Cookies and Session [1L].

Java Server Page (JSP):
JSP Architecture [1L]; JSP Servers, JSP Life Cycle [1L]; Understanding the layout of JSP, JSP
Scriptlet Tag [1L]; JSP implicit object (request and response) [1L]; Variable declaration, methodsin JSP [1L]; JSP directive (Taglib and Include), JavaBean- inserting JavaBean in JSP [1L]; JSPAction tags (Forward & Include) [1L]; Creating ODBC data source name, Introduction to JDBC,prepared statement and callable statement [1L].

Module-4: [6L]
Threats [1L]: Malicious code-viruses, Trojan horses, worms; eavesdropping, spoofing, modification, denial of service attacks.
Network security techniques: Password and Authentication; VPN, IP Security[1L], security in electronic transaction, Secure Socket Layer (SSL), Secure Shell (SSH)[1L].
Firewall (1L): Introduction, Packet filtering, Stateful, Application layer, Proxy.
Search Engine and Web Crawler: Definition, Meta data, Web Crawler[1L], Indexing, Page rank, overview of SEO[1L].

Textbooks:
1. “Web Technology: A Developer's Perspective”, N.P. Gopalan and J. Akilandeswari, PHI
Learning, Delhi, 2013. (Topics covered: html, CSS, imagemap, xml)
2. “Learning PHP, MySQL & JavaScript”, Robin Nixon, O’Reilly Publication. (Topics covered:Java Script)
3. “Head First Servlet’s & JSP”, Bryan Basham, Kathy Sterra, Bert Bates, O’Reilly Publication.
(Topics covered: Servlet, JSP)

4.Cryptography and Network Security by William Stallings Publisher: Pearson Education India(Topics covered: Threats, Security techniques, Firewall)

Recommended books:

1. "Programming the World Wide Web", Robert. W. Sebesta, Fourth Edition, Pearson Education, 2007.
2. "Core Web Programming"- Second Edition-Volume I and II, Marty Hall and Larry Brown, Pearson Education, 2001

CO – PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1		2									
CO2		2	3	2								
CO3		2	2									
CO4	1	2	3	2								
CO5	1		3	2								

Course Name: Parallel and Distributed Algorithms
Course Code: PEC-CS-T-602
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:
Familiarity with the fundamentals of Design and Analysis of Algorithms.

Course Outcome(s):
CO1: Develop the fundamental knowledge of parallel and distributed models
CO2: Design, development, and performance analysis of parallel and distributed algorithms
CO3: Develop and implement parallel and distributed algorithms
CO4: Analyze the performance issues in parallel computing and trade-offs
CO5: Understand the different issues involved in distributed environment

Course Content:

Parallel Algorithms:
Module 1: Parallel Programming Models and Algorithm Design Techniques
Shared-memory model: PRAM, MIMD, SIMD, Network Model: line, ring, mesh, hypercube, Performance measurement of Parallel Algorithms
Design Techniques for PRAM Models Algorithms: Balancing, divide and conquer, parallel prefix computation, pointer jumping, symmetry breaking, pipelining, accelerated cascading

Module 2: Algorithms for Parallel models and complexity
Algorithms for PRAM Models: List ranking, sorting and searching, tree algorithms, graph algorithms, string algorithms
Algorithms for Network Models: Matrix algorithms, sorting, graph algorithms, routing, Relationship with PRAM models

Parallel Complexity: Lower bounds for PRAM models, the complexity class NC, P completeness

Distributed Algorithms:

Module 3: Distributed Models of computation

Models of computation: Shared memory and message passing systems, synchronous and asynchronous systems, Logical time and event ordering. Global state and snapshot algorithms, clock synchronization

Module 4: Distributed Operating Systems

Mutual exclusion, deadlock detection

Classical Algorithms: Leader election, termination detection, distributed graph algorithms

Module 5: Fault tolerance and recovery

Basic concepts, fault models, agreement problems and its applications, commit protocols, voting protocols, check pointing and recovery, reliable communication

Textbooks:

1. Joseph F Jájá, An Introduction to Parallel Algorithms, Addison-Wesley, 1992
2. Mukesh Singhal and Niranjan Shivaratri, Advanced Concepts in Operating Systems, McGraw-Hill

Reference Books:

1. Michael J Quinn, Parallel Computing: Theory and Practice, second edition, McGraw Hill
2. Nancy Lynch, Distributed Algorithms, Morgan Kaufmann
3. Andrew S. Tanenbaum, Distributed Operating Systems, ACM Press
4. Jie Wu, Distributed Systems, CRC Press

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	1	2	-	-	-	2	2	2
CO2	2	3	3	2	2	1	-	-	-	1	2	3
CO3	2	2	3	1	3	2	2	-	-	1	3	2
CO4	1	3	1	3	2	3	2	-	-	3	1	1
CO5	2	1	2	3	2	2	3	-	-	1	2	3

Course Name:

Embedded System
Course Code: PEC-CS-S-602
Contact: 3:0:0
Credits: 3
Total Contact Hours: 36

Prerequisite: Knowledge of microprocessor and microcontroller.

Course Objective(s):

1. An ability to design a system, component, or process to meet desired needs within realistic constraints.
2. Ability to understand microcontroller, microcomputer, embedded system.
3. Understand different components of a micro-controller and their interactions.
4. To become familiar with the programming environment used to develop embedded systems.
5. Understand key concepts of embedded systems like IO, timers, interrupts, interaction with peripheral devices
6. Learn debugging techniques for an embedded system

Course Outcome(s):

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

CO1: Understand the architecture and classifications of different embedded systems and the related programming knowledge.
CO2: Understand the concepts of embedded systems like I/O, timers, interrupts, interaction with peripheral devices
CO3: Choose case-specific debugging technique for an embedded system.
CO4: Design various real time systems using embedded systems.

Module 1: [5L]

Introduction to the Embedded System: Embedded system Vs General computing systems, Purpose of Embedded systems, classifications of embedded systems, fundamentals of embedded processor and microcontrollers, CISC vs. RISC, ASIC.

Module 2: [9L]

Serial and parallel communication: devices and protocols, wireless communication: devices and protocols, parallel communication network using ISA, PCI, PCT-X, Internet embedded system network protocols, USB, Bluetooth.

Module 3: [5L]

Program Modeling Concepts ; Fundamental issues in Hardware software co-design, Unified Modeling Language(UML), Hardware Software trade-offs DFG model, state machine programming model, model for multiprocessor system.

Module 4: [5L]

Real Time Operating Systems: Operating system basics, Tasks, Process and Threads, Multiprocessing and multitasking, task communication, task synchronization, qualities of good RTOS.

Module 5: [12L]

PIC microcontroller: introduction, architecture, comparison of PIC with other CISC and RISC based systems and microprocessors, assembly language programming, addressing modes, instruction set, Interfacing with various sensors and actuators using PIC microcontroller. Programming concepts and embedded programming, embedded architecture.

Text Books:

1. Introduction to Embedded Systems : Shibu K. V. (TMH)
2. Embedded System Design – A unified hardware and software introduction: F. Vahid (John Wiley)

Reference Books:

1. Embedded Systems : Rajkamal (TMH)
2. Embedded Systems : L. B. Das (Pearson)

CO-PO Mapping:

COs for Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12

CO1	3	-	2	1	2	-	-	-	-	-	1	1
CO2	2	1	3	1	-	-	-	-	-	-	2	-
CO3	2	2	3	1	-	-	-	-	-	-	1	2
CO4	3	2	2	-	-	-	-	-	-	-	1	2

Course Name: Soft computing
Course Code: PEC-CS-D-602
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:
Discrete Mathematics, Probability and Statistics

Course Outcome(s):
After completion of the course students will be able to
CO1: Understand the basic concept of soft computing and hard computing and apply them in designing solution to engineering problem.
CO2: Understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications to solving engineering and other problems.
CO3: Apply fuzzy logic and reasoning to handle uncertainty and solving interdisciplinary engineering problems
CO4: Use genetic algorithms to combinatorial optimization problems and recognize the feasibility of applying a soft computing methodology for a particular problem.
CO5: To understand the concept and techniques of designing and implementing of soft computing methods in real world problem.
Course Content:

Module-1: Introduction to Soft Computing: 8L
An Overview of Artificial Intelligence, Evolution of Computing - Soft Computing Constituents – From Conventional Artificial Intelligence to Computational Intelligence - Machine Learning Basics.
Soft Computing: Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing

Module-2: Fuzzy sets and Fuzzy logic 7L
Introduction, Fuzzy sets versus crisp sets, operations on fuzzy sets, Extension principle, Fuzzy relations and relation equations, Fuzzy numbers, Linguistic variables,
Fuzzy logic, Linguistic hedges, Applications, fuzzy controllers, fuzzy pattern recognition, fuzzy image processing, fuzzy database.

Module -3: Artificial Neural Networks 9L
Artificial Neural Network: Introduction, basic models, Hebb's learning, Adeline, Perception, Multilayer feed forward network.
Back propagation, Different issues regarding convergence of Multilayer Perceptron, Competitive learning, Self-Organizing Feature Maps, Adaptive Resonance Theory, Associative Memories, Applications.

Module -4: Genetic Algorithms 7L

Evolutionary and Stochastic techniques: Genetic Algorithm (GA), different operators of Genetic Algorithm, Analysis of selection operations, Hypothesis of building Blocks, Schema theorem and convergence of Genetic Algorithm, Simulated annealing and Stochastic models, Boltzmann Machine, Applications.

Rough Set: Introduction, Imprecise Categories Approximations and Rough Sets, Reduction of Knowledge, Decision Tables, and Applications.

Module -5: Hybrid Systems 5L

Neural-Network-Based Fuzzy Systems, Fuzzy Logic-Based Neural Networks, Genetic Algorithm for Neural Network Design and Learning, Fuzzy Logic controlled Genetic Algorithm. Fuzzy Logic and Genetic Algorithm for Optimization, Applications.

Text book:

1."Neural Networks, Fuzzy logic, and Genetic Algorithms", S. Rajasekaran & G. A. V. Pai , PHI.
2."Principles of Soft Computing", S.N.Sivanandam, S.N Deepa, wiley publications.
3."Neural Networks", S. Haykin, Pearson Education, 2ed, 2001.
4."An Introduction to Genetic Algorithm", Mitchell Melanie, Prentice Hall, 1998.

Reference Books:

1. "Genetic Algorithms in Search, Optimization and Machine Learning", David E. Goldberg, Addison Wesley, 1997.
2."Intelligent Hybrid Systems", D. Ruan, Kluwer Academic Publisher, 1997.

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3								2			
CO2	3	3	3	3	2	2						2			
CO3	3	3	3	3	2	2						2			
CO4	3	3	3	3	2							2			
CO5	3	3	3	3		2			2	2		2			

Name of the Paper: Human computer Interaction
Paper Code: PEC-CS-A-602
Contact (Periods/Week): 3L/Week
Credit Point: 3
No. of Lectures: 36
Prerequisite:
Basic understanding of relevant psychological theories and approaches

Course Objective(s):

The Student Should Be Made to:

- Learn The Foundations of Human Computer Interaction
- Be Familiar with The Design Technologies for Individuals and Persons with Disabilities
- Be Aware of Mobile HCI
- Learn The Guidelines for User Interface

Course Outcome(s):

Upon Completion of the Course, The Student Should Be Able to:
CO1: Design Effective Dialog for HCI.
CO2: Design Effective HCI for Individuals and Persons with Disabilities.
CO3: Assess The Importance of User Feedback.
CO4: Explain The HCI Implications for Designing Web Sites.
CO5: Develop Meaningful User Interface.

Course Content:

Module 1 : FOUNDATIONS OF HCI [7L]
The Human: I/O Channels – Memory – Reasoning And Problem Solving; The Computer: Devices – Memory – Processing And Networks; Interaction: Models – Frameworks – Ergonomics – Styles – Elements – Interactivity- Paradigms.

Module 2 : DESIGN & SOFTWARE PROCESS [7L]
Interactive Design Basics – Process – Scenarios – Navigation – Screen Design – Iteration And Prototyping. HCI in Software Process – Software Life Cycle – Usability Engineering – Prototyping in Practice – Design Rationale. Design Rules – Principles, Standards, Guidelines, Rules. Evaluation Techniques – Universal Design.

Module 3 : MODELS AND THEORIES [7L]
Cognitive Models –Socio-Organizational Issues And Stake Holder Requirements –Communication And Collaboration Models-Hypertext, Multimedia And WWW.

Module 4 : MOBILE HCI [7L]
Mobile Ecosystem: Platforms, Application Frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.

Module 5 : WEB INTERFACE DESIGN [8L]
Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays And Virtual Pages, Process Flow. Case Studies.

Text Books:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, “Human Computer Interaction”, 3rd Edition, Pearson Education, 2004 (Module I, II & III)
2. Brian Fling, “Mobile Design and Development”, First Edition, O'Reilly Media Inc., 2009 (Module –IV)
3. Bill Scott and Theresa Neil, “Designing Web Interfaces”, First Edition, O'Reilly, 2009. (Module-V)

Recommended books:

1. Preece J, Rogers Y, Sharp H, Baniyon D., Holland S. and Carey T. Human Computer Interaction, Addison-Wesley, 1994.
2. B. Shneiderman; Designing the User Interface, Addison Wesley 2000 (Indian Reprint).

CO-PO Mapping:

CO	PO1	PO2	POP3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	3	-	-	-	-	-	-	-	-	2
CO2	1	3	3	-	-	-	-	-	-	-	-	2
CO3	2	3	-	2	-	-	-	-	-	-	-	2
CO4	-	3	-	3	2	-	-	-	-	-	-	2
CO5	1	-	3	-	-	-	-	-	-	-	-	2

Name of the Paper: Introduction to Internet of Things
Paper Code: OEC-CS-601A
Contact (Periods/Week):3L/Week
Credit Point: 3
No. of Lectures: 36

Prerequisite:
1. Fundamental knowledge in computer networking.
2. Basic knowledge of Microcontroller fundamentals.

Course Objective(s):

Students will understand the concepts of Internet of Things and can able to build IoT applications.

Course Outcome(s):
On completion of the course students will be able:

CO1 Understand and differentiate the concepts of Internet of Things and Internet
CO2 Identify appropriate MAC protocols and routing protocols while solving a problem
CO3 Analyze and compare the basic protocols in wireless sensor network and IoT
CO4 Solve different real life problems in different domains based upon the concept of IoT and sensor network
CO5 Implement basic IoT applications on embedded platform

Course Content:

Module 1: [7L]
Fundamental of IoT
The Internet of Things, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Design challenges, Development challenges, Security challenges, Other

challenges.

Module 2: [6L]
Wireless Sensor Network
Network & Communication aspects, Wireless medium access issues, MAC protocol , routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination.

Module 3: [7L]
IoT and M2M
A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

Module 4: [7L]
IoT Architecture
Introduction, ArchitectureReference Model- Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

Module 5: [5L]
IoT Applications for Value Creations
Introduction to Arduino and Raspberry Pi, Cloud Computing, Fog Computing, Connected Vehicles, Data Aggregation for the IoT in Smart Cities,Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT in health care, Value for Industry, smart home Management.

Module 6: [4L]
Internet of Things Privacy, Security and Governance
Introduction, Overview of Governance, Privacy and Security Issues, Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in smart cities, Security.

Text books:

1.Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014.
2.Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013.

Reference books:

1.Cuno Pfister, Getting Started with the Internet of Things, O‟Reilly Media, 2011, ISBN: 978-1-4493-9357-1
2.Waltenegus Dargie,Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"

Table 1: Mapping of Course Outcomes with POs (&PSOs)

CO #	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	3	3	2										

CO2	3	3	3	3	2										
CO3	3	3	3	2	2		1								
CO4	3	3	3	3	3	2	2								
CO5	3	3	3	3	3	2	2		2	2	1	1			

Name of the Paper: Bio-informatics
Paper Code: OEC-CS- 601B
Contact (Periods/Week): L-T-P=3-0-0
Credit Point: 3
No. of Lectures: 35

Course Objective(s):

The student should be made to:

- Be familiar with the modeling techniques.
- Learn microarray analysis.
- Exposed to Pattern Matching and Visualization.

Outcomes: The students will be able to upon completion of the course,

- Develop models for biological data
- Apply pattern matching techniques to bioinformatics data – protein data genomic data.
- Apply micro array technology for genomic expression study

Course Outcome(s):

CO1 To acquire the knowledge of Bioinformatics technologies with the related concept of DNA, RNA and their implications
CO2 To develop idea in MOLECULAR BIOLOGY
CO3 To understand the concept and techniques of different types of Data Organization and Sequence Databases with different types of Analysis Tools for Sequence Data Banks
CO4 To acquire the knowledge of the DNA SEQUENCE ANALYSIS
CO5 To analyze the performance of different types of Probabilistic models used in Computational Biology

Couse Content:

Module -1: **[7L]**
INTRODUCTION TO MOLECULAR BIOLOGY:
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.
Introduction to Bioinformatics. Recent challenges in Bioinformatics.

Module -2: **[10L]**

Introduction to Genomic data, Data Organization and Sequence Databases: Sequence Data Banks - Introduction to sequence data banks - protein sequence data bank. Signal peptide data bank, Nucleic acid sequence data bank - GenBank, AIDS virus sequence data bank. RRNA data bank, structural data banks - protein Data Bank (PDB), The Cambridge Structural Database (CSD) : Genome data bank - Metabolic pathway data : Microbial and Cellular Data Banks.
Introduction to MSDN (Microbial Strain Data Network):Numerical Coding Systems of Microbes, Hibridoma Data Bank Structure, Virus Information System Cell line information system; Protein Sequence Databases, DNA sequence databases. sequence database search programs like BLAST and FASTA. NCBI different modules: GenBank; OMIM, Taxonomy browser, PubMed;

Module 3: [8L]
DNA SEQUENCE ANALYSIS
DNA Mapping and Assembly : Size of Human DNA ,Copying DNA: Polymerase Chain Reaction (PCR), Hybridization and Microarrays, Cutting DNA into Fragments, Sequencing
Secondary Structure predictions;
prediction algorithms; Chao-Fasman algorithm, Hidden-Markov model, Neural
Networking.
Tertiary Structure predictions;
prediction algorithms; Chao-Fasman algorithm, Hidden-Markov model, Neural Networking.

Module -4: [10L]
Introduction Probabilistic models used in Computational Biology:
Probabilistic Models;
Gene Regulatory Method Application of HMM in Bioinformatics : Genefinding, profile searches, multiple sequence alignment and regulatory site identification.
Applications in Biotechnology
: Protein classifications, Fold libraries, Protein structure prediction: Fold recognition
(threading), Protein structure predictions : Comparative modeling (Homology), Advanced topics: Protein folding, Protein-ligand interactions, Molecular Modeling & Dynamics, Drug Designing.

Text Book:
1. Yi-Ping Phoebe Chen (Ed), “BioInformatics Technologies”, First Indian Reprint, Springer Verlag, 2007.

References Book:
1. Bryan Bergeron, “Bio Informatics Computing”, Second Edition, Pearson Education, 2003.
2. Arthur M Lesk, “Introduction to Bioinformatics”, Second Edition, Oxford University Press, 2005

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3					1	1					
CO2		1	2	1						1		1
CO3	1	2		2	2				1			
CO4	2					2	2			1	1	
CO5		3		1		3		1			2	

Paper Name: Robotics

Code: OEC-CS- 601C
Contacts: 3L
Credits: 3
Allotted hours: 35L

Prerequisite:

1. Microprocessor & Microcontroller
2. Computer Organization & Architecture

Course Objective(s):

- To study microcontroller operations for robotics.
- To study how different interfaces are actually implemented in a microcontroller.
- To learn how Microchip PIC micro PIC16F627 can be erased and reprogrammed
- To learn how different sensors, outputs, and peripherals can be wired to a microcontroller to work cooperatively and create a high-level control program.
- To design robots in a real time environment.

Course Outcome(s):
After the successful completion of this course, the student will be able to:

CO1 To describe and explain the microcontrollers used the in robots.
CO2. To design the software and build the prototype of robots.
CO3. To apply localization and mapping aspects of mobile robotics.
CO4. To demonstrate self-learning capability.

Course contents:

Module 1[5L]
Brief history, types, classification and usage, Science and Technology of robots, Some useful websites, textbooks and research journals.

Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using D-H parameters, Examples of D-H parameters and link transforms, different kinds of actuators – stepper, DC servo and brushless motors, model of a DC servo motor, Types of transmissions, Purpose of sensors, internal and external sensors, commonsensors – encoders, tachometers, strain gauge based force-torque sensors, proximity and distance measuring sensors, and vision.

Module 2 [8L]
Introduction, Direct and inverse kinematics problems, Examples of kinematics of common serial manipulators, workspace of a serial robot, Inverse kinematics of constrained and redundant robots, Tractrix based approach for fixed and free robots and multi-body systems, simulations and experiments, Solution procedures using theory of elimination, Inverse kinematics solution for the general 6R serial manipulator.

Degrees-of-freedom of parallel mechanisms and manipulators, Active and passive joints, Constraint and loop-closure equations, Direct kinematics problem, Mobility of parallel manipulators, Closed-from and numerical solution, Inverse kinematics of parallel manipulators and mechanisms, Direct kinematics of Gough-Stewart platform.

Module 3[8L]

Linear and angular velocity of links, Velocity propagation, Manipulator Jacobians for serial and parallel manipulators, Velocity ellipse and ellipsoids, Singularity analysis for serial and parallel manipulators, Loss and gain of degree of freedom, Statics of serial and parallel manipulators, Statics and force transformation matrix of a Gough-Stewart platform, Singularity analysis and statics.

Mass and inertia of links, Lagrangian formulation for equations of motion for serial and parallel manipulators.

Module 4[9L]

Joint and Cartesian space trajectory planning and generation, Classical control concepts using the example of control of a single link, Independent joint PID control, Control of a multi-link manipulator, Non-linear model based control schemes, Simulation and experimental case studies on serial and parallel manipulators, Control of constrained manipulators, Cartesian control, Force control and hybrid position/force control, Advanced topics in non-linear control of manipulators.

Module 5[5L]

Introduction and some well known wheeled mobile robots (WMR), two and three-wheeled WMR on flat surfaces, Slip and its modeling, WMR on uneven terrain, Design of slip-free motion on uneven terrain, Kinematics, dynamics and static stability of a three-wheeled WMR‘s on uneven terrain, Simulations using Matlab and ADAMS.

Introduction to chaos, Non-linear dynamics and chaos in robot equations, Simulations of planar 2 DOF manipulators, Analytical criterion for unforced motion. Gough-Stewart platform and its singularities, use of near singularity for fine motion for sensing, design of Gough-Stewart platform based sensors. Over-constrained mechanisms and deployable structures, Algorithm to obtain redundant links and joints, Kinematics and statics of deployable structures with pantographs or scissor-like elements (SLE‘s).

Textbooks:

1. Myke Predko, ―Programming Robot Controllers‖ – McGrawHill, 1st edition, 2003.

Reference books:

1. Michael slater, ―Microprocessor – based design: A comprehensive Guide to Effective Hardware Design, Prentice Hall, 1989.
2. Myke Predko, ―Programming and customizing the 8051- micro-controller‖, Tata McGraw-Hill, New Delhi, 2000.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	1	1	-	-	-	-	-	-	-
CO2	2	3	-	1	-	-	-	-	-	-	-	-
CO3	2	3	3	-	-	-	-	-	-	-	-	-
CO4	2	2	-	-	-	-	-	-	-	-	-	3

B.Practical

Course Name: Computer Networks Lab
Course Code: PCC-CS691
Contact: 0:0:3
Credit Point: 1.5

Prerequisites:
1. Familiarity and knowledge of Computer Network and Computer Architecture
2. Also require strong knowledge of programming languages like C, Java and UNIX or Linux environment.

Course Outcome(s):
CO1: Demonstrate the socket program using TCP & UDP.
CO2: Develop simple applications using TCP & UDP.
CO3: Develop the code for Data link layer protocol simulation.
CO4: Examine the performances of Routing protocol.
CO5: Experiment with congestion control algorithm using network simulator

Course Contents:

1. Familiarization of UNIX or Linux environment, UNIX or Linux general Commands specially Network Commands. Familiarization of Internetworking - Network Cables - Color coding - Crimping. Internetworking Operating Systems - Configurations. **[6L]**
2. Socket Programming using TCP and UDP **[18L]**
3. Implementing routing protocols such as RIP, OSPF. **[2L]**
4. Familiarization of advanced simulators like Packet Tracer, NS2/NS3, OMNET++, TinyOS**[4L]**
5. Server Configuration: only web server (If time permit, Instructor can do more than that) **[6L]**

Textbooks:
1. TCP sockets in C Programs-Practical guide for Programmers ByMicheal, J Donahoo and Kenneth L calvert.
2. Socket Programming by Raj Kumar Buyaa.

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	3	2	1	1	3	2	2	3
CO2	3	3	3	2	3	3	2	3	3	2	2	3
CO3	3	3	3	2	2	1	2	1	3	2	2	3
CO4	3	3	3	1	2	2	1	3	3	2	2	3
CO5	3	3	3	2	2	2	1	2	3	2	2	3

Course Name: Software Engineering Lab
Course Code: CS 692
Contact: 3:0:0

Total Contact Hours: 36
Credits: 1.5

Prerequisites:
Programming for Problem Solving

Course Outcome(s):

CO1: To understand the basic knowledge of how to apply Software Engineering and mathematical knowledge and designing solution to software engineering problem including the specification, design, implementation, and testing of software systems that meet specification, performance, maintenance and quality requirements

CO2: To analyze the cost-benefit trade-off, functional, non-functional and technical requirements through a productive working relationship with various stakeholders of the project.

CO3: Design solutions to the one or more application domains using software engineering approaches that integrates ethical, social, legal and economic concerns.

CO4: To develop the code from the design and effectively apply relevant standards and perform testing, and quality management and practice team work.

CO5: To identify and use of modern software engineering tools necessary for software project management, time management and software reuse, and an ability to engage in life long learning.

CourseContent:

Module-1:[6L]

Preparation of requirement document for standard application problems in standard format. (e.g. LibraryManagement System, Railway Reservation system, Hospital management System, University Admission system) .DFD of standard application problems.

Module-2:[6L]

Software Requirement Analysis: Describe the individual Phases/ modules of the project, Identify deliverables. Compute Process and Product Metrics (e.g Defect Density, Defect Age, Productivity, Cost etc.) Estimation of project size using Function Point(FP) for calculation.

Cost Estimation models. L

Module-3: [6L]

Use Case diagram, Class Diagram, Sequence Diagram, Activity Diagram and prepare Software Design Document using tools like Rational Rose.(For standard application problems)

Module-4:[9L]

Software Development, Coding Practice and Debugging, Design Test Script/Test Plan(both Black box and White Box approach)

Module-5:[9L]

Software project management, Project planning and control, configuration control, cost estimation, project scheduling using PERT and GANTT charts, cost-time relations using standard tools.

Text Books:
1. Fundamentals of Software Engineering by Rajib Mall, –PHI-3rd Edition, 2009.
2.SoftwareEngineering-PankajJalote(Wiley-India)

Reference Books:
1.SoftwareEngineering–AgarwalandAgarwal(PHI)
2.Software Engineering, by Ian Sommerville, Pearson Education Inc., New Delhi, (2009).
3. Software Engineering: A Practitioner"s Approach", by Roger S. Pressman, McGraw-Hill.(2005)

CO–POMapping:

PO&PSOMapping															
										0	**1**	**2**	**1**	**2**	**3**
1															
2															
3															
4															
5															

Course Name: Microprocessors & Microcontrollers Lab
Course Code: PEC-CS-T-691
Contact: 0:0:3
Credits: 1.5

Prerequisites:

1. Familiarity with the numbersystem
2. A solid background in digital logic and implementation of digital circuit in a breadboard.

Course Objective(s):

- To learn the assembly language programming of amicroprocessor.
- To learn the assembly language programming of amicrocontroller.
- To learn the interfacing ofmicroprocessor.
- To be familiar with microprocessor and microcontroller basedprojects.

CourseOutcome(s):

CO1: To understand and apply the fundamentals of assembly level programming ofmicroprocessors andmicrocontroller
CO2: To work with standard microprocessor real time interfaces including GPIO, serial ports, digital-to-analog converters and analog-to-digital converters.
CO3: To troubleshoot interactions between software and hardware**.**
CO4: To analyze abstract problems and apply a combination of hardware and software to address the problem

Course Contents:

Module -1: [3L]

Study of Prewritten programs on 8085 trainer kit using the basic instruction set (data transfer,Load/Store, Arithmetic, Logical).
Or,
Familiarization with 8085 simulator on PC.
Programs using basic instruction set (data transfer,Load/Store, Arithmetic, Logical) on the simulator.
Module -2: [24L]

Programming using kit or Simulator for:

1. Table lookup
2. Copying a block ofmemory
3. Shifting a block ofmemory
4. Packing and unpacking of BCDnumbers
5. Addition of BCDnumbers
6. Binary to ASCII conversion and vice-versa (Using SubroutineCall)
7. BCD to Binary Conversion andvice-versa
8. HCF of twonumbers
9. Addition of numbers usingsubroutine
10. Clearing the flagregister

Module -3: [3L]
Study of Prewritten programs on 8051 Microcontroller Kitusing the basic instruction set (datatransfer, Load/Store, Arithmetic, Logical).
Or,
Familiarization with 8051 Simulator on PC.
Study of prewritten programs using basic instruction set (data transfer, Load/Store, Arithmetic, Logical).

Text Books:
1. MICROPROCESSOR architecture, programming and Application with 8085 - R.Gaonkar (Penram international PublishingLTD.)
2. Fundamentals of Microprocessor and Microcontrollers - B. Ram(Paperback)
3. 8051 Microcontroller – K. Ayala (Cengagelearning)

Reference books:
1. The 8051 microcontroller and Embedded systems - Mazidi, Mazidi and McKinley (PEARSON)

CO-PO Mapping:

	CO & PO Mapping											
	PO1	PO2	POP3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	–	–	–	–	–	–	–	–	–	–
CO2	–	–	2	–	–	–	–	–	–	–	–	–
CO3	1	–	2	–	–	–	–	–	–	–	–	–
CO4	2	3	–	–	–	–	–	–	–	–	–	–

Course Name: Advanced Operating Systems Lab
Course Code: PEC-CS-S-691
Contact:0:0:3
Total Contact Hours: 36
Credits: 1.5

Prerequisites: Operating Systems

Course Objective(s):

The objective of the course is to make the students able to -

- Understand and execute basic commands of shell script
- Apply basic operations in shell scripts which are required for different applications.
- Identify and understand concept of file systems in shell script
- able to understand the concept of creating new process from parent process.
- Able to understand concept of virtual file and execute basic commands on it

Course Outcome(s):

After completion of the course students will be able to
CO1:Understand and implement basic services and functionalities of the operating system using system calls and able to Understand the benefits of thread over process and implement synchronized programs using multithreading concepts.
CO2:Analyze the design aspects and issues of distributed operating systems.
CO3:Analyze and simulate CPU Scheduling Algorithms like FCFS, Round Robin, SJF, and Priority.
CO4: Implement memory management schemes and page replacement schemes
CO5:Understand the concepts of deadlock in operating systems and implement them inMultiprogramming system.

Course Content:

Preliminaries of Operating System: 6P
managing users, managing systems, file managements, useful commands, Shell scripting : shell syntax, executing shell scripts.

Process : 12P
creating new process, counting maximum number of processes a system can handle at a time, handling system calls; inter process communication through pipes and message passing, zombie process, orphan process.

Process Synchronization: 6P

handling threads and semaphores to achieve synchronization among processes using POSIX standard functions.

Signal : 6P
study of some POSIX signals (SIGINT, SIGILL, SIGFPE, SIGKILL, SIGHUP, SIGALRM, SIGABRT).

Text book:
1. Mukesh Singhal and Niranjan Shivaratri, Advanced Concepts in Operating Systems, McGraw-Hill.

Reference Books:
1.Nancy Lynch, Distributed Algorithms, Morgan Kaufmann.

CO – PO Mapping:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3											
CO2	3	3	3	3											
CO3	3	3	3	3								3			
CO4	3	3	3	3											
CO5	3	3	3	3					3	3					

Course Name: Machine Learning Lab
Course Code: PEC-CS-D-691
Contact:0:0:3
Total Contact Hours: 36
Credits: 1.5

Course Objective(s):
This course will enable students to
- Make use of Data sets in implementing the machine learning algorithms
- Implement the machine learning concepts and algorithms in any suitable language of choice

Course Outcome(s):
The students should be able to:
CO1. Understand the implementation procedures for the machine learning algorithms.
CO2. Design Java/Python programs for various Learning algorithms.
CO3. Apply appropriate data sets to the Machine Learning algorithms.
CO4. Identify and apply Machine Learning algorithms to solve real world problems.

List of Lab Experiments:
1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.

2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.

3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

4. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.

5. Write a program to implement the naÔve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.

6. Assuming a set of documents that need to be classified, use the naÔve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.

7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.

8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

9. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.

10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	4	4								3	
CO2		4	4	3	4	3						
CO3		3		3	3	3						
CO4	3	4		4		3						

Name of the Paper: Web and Internet Technology Lab
Paper Code: PEC-CS-A-691
Contact (Periods/Week): 3P/Week
Credit Point: 2
No. of Lectures: 30

Prerequisite:
Fundamentals of Programming

Course Objective(s):
- To impart the design, development and implementation of Static and Dynamic Web Pages
- To develop programs for Web using Scripting Languages and .net framework
- To give an overview of Server Side Programming in Web

Course Outcome(s):
CO1: To develop interactive web pages using HTML, DHTML, CSS and image map

CO2: To procure the knowledge of information interchange formats like XML
CO3: To validate fields of web pages using scripting languages like JavaScript
CO4:To acquire the server side programming concepts using servlet, JSP

List of Experiments:

1. Write a single html program through which you can explain a) anchor tag, b)'img' tag with 'src'attribute, c)paragraph d) heading.
2. Write a single html program through which you can draw a table which consists of 3 row and 4columns where 1st row contains 4 different column fields of a student's information with red textcolor and Calibri font style with font 12. Rest cells of whole table contain values with blue text colorsand Times new roman font style with font 10.
3. Write a single html program where 1st paragraph can collect its specified style from internal stylesheet describes inside that html program and 2nd paragraph can collect its specified style fromanother file (external stylesheet).
4. Write a single html program which implements image map concept using 'usemap' and <map>.
5. Write a html program to find out Celsius temperature of a given Fahrenheit temperature usingJavaScript.
6. Write a xml parsing technique through which parse a text string into an XML DOM object andextracts the info from it with JavaScript.
7. Write a html program to find out m to the power n (m, n valid integer no) using a function usingJavaScript.
8. Write a simple java script program to print the weekday and time.
9. Write a simple java script program to implement the function using the argument and no argument both.
10. Write a simple program in ASP.net through which you can create a login page of your own website.
11. Write a simple JSP program through which you can print even and odd no separately within agiven range.
12. Create an Online Registration form for individual user of an website using Servlet.

Textbooks:

1. "Web Technology: A Developer's Perspective", N.P. Gopalan and J. Akilandeswari, PHI Learning, Delhi, 2013. (Topics covered: html, CSS, imagemap, xml)
2. "Learning PHP, MySQL & JavaScript", Robin Nixon, O'Reilly Publication.(Topics covered:Java Script)
3. "Head First Servlet's & JSP", Bryan Basham, Kathy Sterra, Bert Bates, O'ReillyPublication. (Topics covered: Servlet, JSP)

Recommended books:

1. "Programming the World Wide Web", Robert. W. Sebesta, Fourth Edition, Pearson Education,2007.
2. "Core Web Programming"- Second Edition-Volume I and II, Marty Hall and Larry Brown, Pearson Education, 2001.
3. "Web Technologies", Black Book, Dreamtech Press

CO – PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1		2									
CO2		2	3	2								
CO3		2	2									
CO4	1	2	3	2								
CO5	1		3	2								

C.Mandatory Course

Course Name: Intellectual Property Right
Course Code: MC 601
Contacts: 2L:0T:0P
Total Contact Hours: 24
Credit: 0

Prerequisite: None

Course Outcome(s):
On successful completion of the learning sessions of the course, the learner will be able to:
CO1: Explain fundamental aspects of Intellectual property Rights to students
CO2: To disseminate knowledge on patents, patent regime in India and abroad and registration aspects
CO3: To disseminate knowledge on copyrights and its related rights and registration aspects
CO4: To disseminate knowledge on trademarks and registration aspects
CO5: To disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects
CO6: To aware about current trends in IPR and Govt. steps in fostering IPR

Course Content:

Module 1: [4L]
Overview of the IPR: Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development – IPR in abroad - International organizations. Agencies and treaties,

Module 2:[4L]
Patents- Trips Definition, kind of inventions protected by patent-Patentable and Non patentable inventions. Elements of Patentability: Novelty , Non Obviousness (Inventive Steps), Le8al requirements for patents — Granting of patent - Rights of a patent-exclusive right. Patent application process: Searching a patent- Drawing of a patent- Filing of a patent- Types of patent applications- Parent document: specification and Claims.
Registration Procedure, Rights and Duties of Patentee, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties

Module 3: [4L]
Trademarks- Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Registration of Trademarks - Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties - trade mark registration processes.

Module 4:[4L]
Copyrights- Right and protection covered by copyright - Law of copy rights: Fundamental of copyright law. originality **of material,** rights of reproduction, rights to perform the worth publicly, copy right ownership

issues, obtaining copy right registration, notice of copy right. International copy right law. Infringement of Copyright under Copyright Act

The Role arid Liabilities of lPRs in India - Cyberlaw issues: Criminallaw. data safety, online privacy. Health privacy, Freedom of expression and human rights, net neutrality, national security.

Module 5: [4L]

Geographical Indication of Goods: Types, why and how GI need protection and GI laws. Indian GI act. Industrial Designs: protection. Kind of protection provided by industrial designs. Integrated Circuits

Module 6: [4L]

India`s New National IP Policy, 2016 – Govt. of India step towards promoting IPR – Govt. Schemes IPR – Career Opportunities in IP - IPR in current scenario with case studies

Text book:

1. Fundamentals oflP for Engineers: K.Bansl& P.Bansal
2. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
3. Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.

Reference book:

1. Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	3		1	2	3			2		2	3	3	1	2	3
CO 2	3	1		1			1		1		3	3		1	
CO 3	3		1	2	3			2		2	3	3	1	2	3
CO 4	3	1		1			1		1		3	3		1	
CO 5	3		2		2	3				2	3	3	2		2
CO 6	3	2		1				2	2		3	3		1	