Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering and Technology
(Autonomous Institute)

Faculty of Science and Technology

Board of Studies

Information Technology

Syllabus

B.Tech. Information Technology

(2023 Pattern)

(w.e.f. AY: 2026-27)

Institute Vision and Mission

Vision

To achieve Academic Excellence through Persistent and Synergic Collaborations amongst all Stakeholders.

Mission

- To ensure holistic development of students as lifelong learners and problem solvers through value-based quality education.
- To motivate faculty to attain the state-of-the-art knowledge and wisdom in their domain and be a facilitator towards co-creation of knowledge.
- To frame and deploy conducive and empowering policies for multifaceted growth of students, faculty and staff to make them contributors towards excellence.
- To partner with industry for mutually beneficial relations to generate employable and deployable workforce.
- To fulfill the aspirations of alumni, parents, society, region and nation at large by generating technically competent and contributing manpower.

Department Vision and Mission

Vision

To develop globally competent IT professionals through continuous learning.

Mission

- To provide graduates with the programming skills and domain knowledge.
- To collaborate with local, state, national, and international entities in education.
- To develop technically competent professionals with social values and ethics.
- To encourage faculty to acquire state-of-the art knowledge.

Program Educational Objectives	
PEO1	Graduates of the program will possess strong fundamental concepts in mathematics, science, engineering and Technology to address technological challenges.
PEO2	Possess knowledge and skills in the field of Computer Science & Engineering and Information Technology for analyzing, designing and implementing complex engineering problems of any domain with innovative approaches.
PEO3	Possess an attitude and aptitude for research, entrepreneurship and higher studies in the field of Computer Science & Engineering and Information Technology.
PEO4	Have commitment to ethical practices, societal contributions through communities and lifelong learning.
PEO5	Possess better communication, presentation, time management and team work skills leading to responsible & competent professionals and will be able to address challenges in the field of IT at global level.

Program Outcomes		
PO1	Engineering knowledge	Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
PO2	Problem analysis	Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
PO3	Design / Development of Solutions	Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
PO4	Conduct Investigation of Complex Problems	Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
PO5	Engineering Tool Usage	Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
PO6	The Engineer and The World	Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
PO7	Ethics	Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
PO8	Individual and Collaborative Team work	Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO9	Communication	Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
PO10	Project Management and Finance	Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PO11	Life-Long Learning	Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.(WK8)

Program Specific Outcomes(PSO)	
PSO1	Students will be able to apply engineering principles and practices for the development and maintenance of software system.
PSO2	Students will be able to undertake a team project by following professional ethical practices.
PSO3	Students will be able to make successful career in IT industry meeting the requirement of industries.

SEMESTER-VII

Course Type	Course Code	Course Name	Teaching Scheme			Examination Scheme and Marks							Credits			
			TH	PR	TUT	CAA	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
IJOT	IT23401 PR	Internship/ On-job Training	-	24	-	100	-	-	100	-	150	350	-	12	-	12
EEMC	HS23401 TH	Software Project Management	3	-	-	30	-	70	-	-	-	100	3	-	-	4
	HS23401 TUT	Software Project Management	-	-	1	-	-	-	-	-	30	30	-	-	1	
RM	HS23403 TH	Research Methodology and IPR	3	-	-	30	-	70	-	-	-	100	3	-	-	4
	HS23403 TUT	Research Methodology and IPR	-	-	1	-	-	-	30	-	-	30	-	-	1	
AEC	HS23404 TH	Public Speaking and Aptitude	1	-	-	40	-	-	-	-	-	40	1	-	-	2
	HS23404 TUT	Public Speaking and Aptitude	-	-	1	-	-	-	-	-	30	30	-	-	1	
Total			**7**	**24**	**3**	**200**	**-**	**140**	**130**	**-**	**210**	**680**	**7**	**12**	**3**	**22**

SEMESTER-VIII

Course Type	Course Code	Course Name	Teaching Scheme			Examination Scheme and Marks							Credits			
			TH	PR	TUT	CAA	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
PCC	IT23411TH	Distributed Systems	3	-	-	10	30	60	-	-	-	100	3	-	-	4
	IT23411 PR	Distributed Systems	-	2	-	-	-	-	-	30	-	30	-	1	-	
PEC	IT23412X TH	Program Elective IV	3	2	-	10	30	60	-	-	-	100	3	-	-	4
	IT23412X PR	Program Elective IV	-	-	-	-	-	-	-	-	30	30	-	1	-	
PEC	IT23413X TH	Program Elective V	2	-	-	10	-	60	-	-		100	2	-	-	3
	IT23413X PR	Program Elective V	-	2	-	-	-	-	-	-	30	30	-	1	-	
MDM	MDM23XX X TH	MDM	2	-	-	20	20	50	-	-	-	90	2	-	-	3
	MDM23XX X PR	MDM	-	2	-	-	-	-	20	-	-	20	-	1	-	
PROJ	IT23414 PR	Project	-	8	-	-	-	-	80	-	50	130	-	4	-	4
OE	OE230XX TH	Open Elective	2	-	-	-	-	50	-	-	-	50	2	-	-	2
	Total		**12**	**16**	**-**	**50**	**80**	**280**	**100**	**30**	**110**	**650**	**12**	**8**	**-**	**20**

Prof.S.A.Takale
HOD-IT

Dr.A.H. Kolekar
CoE

28/03/2026
Prof.S.M.Bhosle
Dean Academics

Prof.S.B.Lande
Principal

KBIET BARAMATI
Affiliated to S.P.P.U. Pune Id No./PU/PN/ Engg./152/2000
ME (MS.)

Principal
Vidya Pratishthan's
Kamalnayan Bajaj Institute of
Engineering & Technology, Baramati
Vidyanagari, Baramati-413133

Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering and Technology
Board of Studies: Information Technology
Syllabus: B. Tech. Information Technology
2023 Pattern w.e.f. AY:2026-2027

SEMESTER-VII

Course Type	Course Code	Course Name	Teaching Scheme			Examination Scheme and Marks							Credits			
			TH	PR	TUT	CAA	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
IJOT	IT23401 PR	Internship/ On-job Training	-	24	-	100	-	-	100	-	150	350	-	12	-	12
EEMC	HS23401 TH	Software Project Management	3	-	-	30	-	70	-	-	-	100	3	-	-	4
	HS23401 TUT	Software Project Management	-	-	1	-	-	-	-	-	30	30	-	-	1	
RM	HS23403 TH	Research Methodology and IPR	3	-	-	30	-	70	-	-	-	100	3	-	-	4
	HS23403 TUT	Research Methodology and IPR	-	-	1	-	-	-	30	-	-	30	-	-	1	
AEC	HS23404 TH	Public Speaking and Aptitude	1	-	-	40	-	-	-	-	-	40	1	-	-	2
	HS23404 TUT	Public Speaking and Aptitude	-	-	1	-	-	-	-	-	30	30	-	-	1	
Total			**7**	**24**	**3**	**200**	**-**	**140**	**130**	**-**	**210**	**680**	**7**	**12**	**3**	**22**

28/03/2026

Prof.S.A.Takale
HOD-IT

Dr.A.H. Kolekar
CoE

Prof.S.M.Bhosle
Dean Academics

Prof.S.B.Lande
Principal

VPKBIET BARAMATI
Affiliated to S.P.P.U: Pune Id No./PU/PN/Engg./152/2000
PUNE (MS.)

Principal
Vidya Pratishthan's
Kamalnayan Bajaj Institute of
Engineering & Technology, Baramati
Vidyanagari, Baramati-413133

SEMESTER-VIII

Course Type	Course Code	Course Name	Teaching Scheme			Examination Scheme and Marks							Credits			
			TH	PR	TUT	CAA	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
PCC	IT23411TH	Distributed Systems	3	-	-	10	30	60	-	-	-	100	3	-	-	4
	IT23411PR	Distributed Systems	-	2	-	-	-	-	-	30	-	30	-	1	-	
PEC	IT23412XTH	Program Elective IV	3	-	-	10	30	60	-	-	-	100	3	-	-	4
	IT23412XPR	Program Elective IV	-	2	-	-	-	-	-	-	30	30	-	1	-	
PEC	IT23413XTH	Program Elective V	2	-	-	10	-	60	-	-	-	100	2	-	-	3
	IT23413XPR	Program Elective V	-	2	-	-	-	-	-	-	30	30	-	1	-	
MDM	MDM23XXXTH	MDM	2	-	-	20	20	50	-	-	-	90	2	-	-	3
	MDM23XXXPR	MDM	-	2	-	-	-	-	20	-	-	20	-	1	-	
PROJ	IT23414PR	Project	-	8	-	-	-	-	80	-	50	130	-	4	-	4
OE	OE230XXTH	Open Elective	2	-	-	-	-	50	-	-	-	50	2	-	-	2
	Total		**12**	**16**	**-**	**50**	**80**	**280**	**100**	**30**	**110**	**650**	**12**	**8**	**-**	**20**

Elective –IV		
Sr. No	**Course Code**	**Course**
1	IT23412A	Cloud Computing
2	IT23412B	GPU Programming
3	IT23412C	Information Retrieval Systems

Elective -V		
Sr. No	**Course Code**	**Course**
1	IT23413A	Mobile Computing
2	IT23413B	Blockchain Technology
3	IT23413C	Natural Language Processing

Prof.S.A.Takale
HOD-IT

Dr.A.H.Kolekar
CoE

28/03/26
Prof.S.M.Bhosle
Dean Academics

Prof.S.B.Lande
Principal

VPKBIET BARAMATI
Affiliated to S.P.P.U. Pune Id No./PU/PN/Engg./152/2000

Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering & Technology, Baramati
Vidyanagari, Baramati-413133

Multidisciplinary Minor Courses			
Course Code	**Course Name**	**Course Code**	**Course Name**
AI23051	AI & Machine Learning	ET23053	Internet of Things
AI23052	Data Science	CE23051	Waste Management
AI23053	Generative AI (Sem V+)	CE23052	Green building & smart cities
CO23051	Cloud Computing	ME23051	3-D Printing
CO23052	High Performance Computing (Sem V+)	ME23052	Robotics & Automation
CO23053	Computer Graphics & Gaming	EL23051	Solar Technology
IT23051	Cyber security	EL23052	Industrial Automation
IT23052	Full Stack Development	GS23051	Nanotechnology
ET23051	Embedded Systems	GS23052	Linear Algebra and Statistics
ET23052	Drone Technology		

Open Elective Courses			
Course Code	**Course Name**	**Course Code**	**Course Name**
OE23001	Digital Marketing	OE23011	Biotechnology
OE23002	Professional Leadership	OE23012	International Relations
OE23003	Organizational Behavior	OE23013	Universal Human Values
OE23004	Industrial Management	OE23014	Education Technology
OE23005	Disaster Management	OE23015	Design Thinking
OE23006	Energy Economics & Management	OE23016	Accounting & Finance
OE23007	Operations Research	OE23017	Sustainability & Climate Change
OE23008	Intellectual Property Rights	OE23018	Agriculture Technology
OE23009	Cyber Laws	OE23019	Architectural Technology
OE23010	Bioinformatics		

SEMESTER-VII

Internship/On-job Training

Course Code : IT23401	Course Credits: 12	Course type: IJOT

Teaching Scheme			Evaluation Scheme					
TH	PR	TUT	CAA	ISE	ESE	TW	PR	OR
-	24	-	100	-	-	100	-	150

Prerequisite Course Mapping:
Students should have successfully completed Semester VI of the Engineering program

Course Objectives:
1. To learn and practice hands-on technical skills.
2. To provide opportunities for acquiring, comprehending, and refining practical technical proficiencies.
3. To gain exposure to professional industrial practices and environments.
4. To understand how real-world factors like cost, society, and management affect a company.
5. To cultivate ethical principles aligned with professional and societal standards

Course Outcomes:
1. Understand how people in the industry approach and solve problems.
2. Learn how to write clear and effective technical reports.
3. Work effectively and professionally as part of a team.
4. Learn to pick the right tools and technology to solve a given problem.
5. Analyze various career opportunities and decide career goals.
6. Demonstrate abilities of a responsible professional and use ethical practices in day-to-day life.

Internship work Identification:
Student may choose to undergo Internship at Industry/Govt. Organizations/NGO/MSME/Rural Internship/ Innovation/IPR/Entrepreneurship. Student may choose either to work on innovation or Entrepreneurial activities resulting in start-up or undergo internship with industry/NGO's/Government organizations/Micro/Small/ Medium enterprises to make themselves ready for the industry. Internship work identification process should be initiated in the VI semester in coordination with training and placement cell/ industry institute cell. This will help students to start their internship work on time.
Student can take internship work in the form of the following but not limited to:
1. Working for consultancy/ research project,
2. Contribution in Incubation/ Innovation/ Entrepreneurship Cell/ Institutional Innovation Council/ startups cells of institute /
3. Learning at Departmental Lab/ Institutional workshop,
4. Development of new product/ Business Plan/ registration of start-up,
5. Industry / Government Organization Internship,
6. Internship through Internshala,
7. In-house product development, intercollegiate, inter department research internship under research lab/group, micro/small/medium enterprise/online internship,
8. Research internship under professors, IISC, IIT's, Research organizations,
9. NGOs or Social Internships, rural internship,
10. Participate in open source development.

Duration:
Internship is to be completed after semester 6 and before commencement of semester 8 of at least 14 to 20 weeks; and it is to be assessed and evaluated in semester 7.

Guidelines for students
1. All B.Tech students are required to undergo an internship for a minimum duration of 14–16 weeks.

Students must obtain a Final Year - Bonafide Certificate through the college office, which is mandatory for commencing the internship.

2. Student must submit application form with all documents and Undertaking forms to department IIIC Coordinator through mentor
3. Students can take mini projects, assignments, case studies by discussing it with concerned authority from industry and can work on it during internship.
4. All students should compulsorily follow the rules and regulations as laid by industry.
5. Every student should take prior permissions from concerned industrial authority if they want to use any drawings, photographs or any other document from industry.
6. Student should follow all ethical practices and SOP of industry.
7. Students have to take necessary health and safety precautions as laid by the industry.
8. Student should contact his /her academic guide from college on weekly basis to communicate the progress.
9. Each student has to prepare internship report in consultation with the academic guide.

Internship Diary / Internship Workbook

1. Students must maintain a daily diary in the format prescribed by the college, documenting observations, tasks performed, information gathered, and any suggestions.
2. The diary should include relevant sketches, drawings, or diagrams based on daily observations.
3. The industry supervisor or section in-charge must verify and sign the diary every week.
4. Students must present the diary to the Faculty Mentor during each industry visit for verification and ratification.
5. Upon completion of the internship, students must submit the following to the Institute: o
    - Student's Daily Diary (as per college format)
    - Internship Report
    - Attendance Record
    - Evaluation Sheet duly signed and stamped by the industry

6. The diary will be evaluated based on **regularity of entries, completeness, and adherence to the prescribed format**.

Internship Report

1. Students must prepare a comprehensive internship report in the format prescribed by the department, covering observations, tasks performed, and key learning outcomes.
2. Students may consult the Industry Supervisor and Faculty Mentor to obtain specific topics or problem statements to be included in the report.
3. Students should use the daily diary as a reference while preparing the report, as it already contains detailed information recorded during the internship.
4. The completed report must be signed by the Industry Supervisor and Faculty Mentor before submission to the department.
5. The internship report will be evaluated based on the following criteria:
    - Originality of content
    - Adequacy and purposefulness of the write-up
    - Organization, formatting, quality of sketches/drawings, writing style, and language
    - Variety and relevance of the learning experiences documented
    - Linkage of practical applications with theoretical concepts learned in coursework

Evaluation Guidelines:

Every student is required to prepare and maintain documentary proofs of the activities done by him/her as internship diary or as workbook. The evaluation of these activities will be done by Department IIIC Coordinator / faculty mentor or Industry Supervisor/Appointed External Examiner based on- Overall compilation of internship activities, sub-activities, the level of achievement expected, evidence needed to

assign the points and the duration for certain activities. Assessment and Evaluation is to be done in consultation with internship supervisor (Internal and External – a supervisor from place of internship.)

Component	**Marks**
A. Continuous Assessment Activity	100
B. Term-Work (Internship Report)	100
C. Oral Examination / Viva	150
TOTAL	**350**

1. Continuous Assessment (100 Marks): Evaluation includes attendance, discipline, workplace behavior, and the quality of the learning diary or logbook. Mid-semester progress presentations and structured industry supervisor feedback form an integral part of the continuous review process.

2. Term-Work (150 Marks): Assessment covers the structure and completeness of the internship report, technical depth, problem-solving ability, and reflection on skills developed. Supporting evidence—drawings, screenshots, certificates, and attendance records—is verified, along with a plagiarism check to ensure originality.

3. Oral Examination / Viva (150 Marks): Evaluation focuses on understanding of tasks performed, application of engineering concepts, clarity of communication, industry relevance, and the ability to respond logically during interaction with examiners. Joint assessment by internal and external examiners ensures transparency and fairness.

Internship Evaluation Scheme(Total :350 Marks)

Component	**Marks**	**Evaluation Basis**	**Mode of Assessment /Evaluator**
A. Continuous Assessment (50 Marks)			
Attendance, Discipline & Professionalism	20	Regularity, punctuality, adherence to workplace culture	Attendance record + Industry Supervisor note
Diary / Logbook	20	Weekly reflection of tasks, learning outcomes, challenges	Logbook review by Faculty Mentor
Mid-Semester Progress Presentation	20	Presentation on tasks performed, tools/technologies learned, contributions	Faculty review (in consultation with Industry Supervisor)
Industry Supervisor Feedback	40	Attitude, initiative, teamwork, professional conduct	Structured feedback form
Subtotal(A)	**100**		
B. Term-Work (Internship Report)- (100 Marks)			
Internship Report (Structure & Completeness)	20	Cover page, acknowledgement, organization profile, objectives, methodology, tasks, outcomes, conclusion	Faculty Panel Evaluation
Technical Content & Problem Solving	30	Depth of technical work, relevance to discipline, engineering application	Faculty Panel
Skill Development Reflection	20	Technical/professional skills, tools learned, employability skills (NEP focus)	Faculty Panel
Evidence & Annexures	15	Screenshots, codes, drawings, certificates, datasheets, attendance logs	Faculty Panel
Plagiarism / Originality	15	Minimum 80% originality; no copy-paste	Plagiarism check + Faculty review
Subtotal (B)	**100**		
C. Presentation & Oral Examination / Viva (100 Marks)			

Understanding of Work Done	30	Explanation of tasks performed, process understanding, technical depth	Internal + External Examiners
Application of Knowledge	30	Linkage with curriculum, application of engineering concepts	Viva Panel
Soft Skills & Communication	30	Presentation skills, clarity, professional conduct	Viva Panel
Industry Relevance & Employability	30	Awareness of industry practices, teamwork, adaptability	Viva Panel (Industry input)
Q&A Interaction	30	Logical reasoning and accuracy of responses	Viva Panel
Subtotal (C)	**150**		
Total A+B+C 350			

Feedback from internship supervisor

Post internship, faculty coordinator/Mentor should collect feedback about student with recommended parameters include as- Technical knowledge, Discipline, Punctuality, Commitment, Willingness to do the work, Communication skill, individual work, Team work, Leadership

Reference:

1. https://internship.aicte-india.org/
2. Circular No.29-2004 Internship Cell-BOD Link_15022024.pdf
3. https://www.aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf

Software Project Management								
Course Code : HS23401			**Course Credits: 04**			**Course type: EEMC**		
Teaching Scheme			**Evaluation Scheme**					
TH	**PR**	**TUT**	**CAA**	**ISE**	**ESE**	**TW**	**PR**	**OR**
3	**-**	**1**	**30**	**-**	**70**	**-**	**-**	**30**

Prerequisite Course Mapping:
1. Software Engineering

Future Course Mapping:
1. Projects, Internships, and Professional Practice

Course Objective:
1. To discuss the fundamentals of Software Project Management
2. To explain Project Design and Project Evaluation.
3. To acquire skill in Activity Planning and to deal with Risk Management
4. To provide a platform to understand through different tools about Project Tracking, Monitoring & Control.
5. To discuss the Staff Selection Process and the issues related to Staff Management.
6. To provide exposure to modern tools used for Software Project Management

Course Outcomes: On completion of the course, learner will be able to
1. **Understand** the practices and methods for successful Software Project Management.
2. **Design** and Evaluate Project.
3. **Analyze** Project Schedule and estimate Risk Management with help of tools.
4. **Identify** Staff Selection Process and the issues related to team Management.
5. **Demonstrate** different tools used for Project Monitoring & Control.
6. **Apply** modern tools for Software Project Management.

Syllabus

UNIT NO.	Syllabus	Hrs
I	**Introduction to Software Project Management** Traditional Project Management, Basics Of Software Project Management, Software Crisis, Challenges In Software Project Management, Project Scope, Activities, Stakeholders, Project Success And Failure, Jobs Vs Project, Project Vs Products, Minimum Viable Product (MVP) and Product-Led Growth (PLG), Technical Debts - Common Causes, Types Of Debts, Consequences, Managing Tech Debts - Role Of GenAI in Tech Debts, Business Case, Traditional Vs Modern Project Management. **Case Study:** Online Shopping System.	7
II	**Project Evaluation and Estimation** **Project Evaluation:** Importance Of Project Evaluation, Cash-Flow Forecasting, Cost Benefit Analysis. **Project Estimation**- Taxonomy, Estimation Techniques-Function Point, Cocomo Model, Staffing Estimation, FinOps (CloudfinOps) - What Is FinOps, Three Pillars Of FinOps, Stakeholders, Reporting and Automation in FinOps. **Case Study:** Online Shopping System, Perform Cost-Benefit Analysis Using Microsoft Excel	6
III	**Project Scheduling & Risk Management** Objectives Of Activity Planning, Scheduling Sequence, WBS, Network Planning Models Formulating Network Model – Forward Pass & Backward Pass Techniques, Project Crashing. **Risk Management**- Introduction, Risk Assessment, Risk Control, Risk Strategies, Study Risk Management Tools - Spiraplan By Inflectra, Risk Management Studio. Predictive Risk Analysis - Types, Benefits, Model.	6

	Case Study: Online Shopping System	
IV	**Managing People and Organizing Teams** **Understanding Behaviour**: Organizational Behaviour, Maslow's Hierarchy, The Oldham-Hackman Job Characteristics Model, Understand Team Effectiveness - Definition Team, Effectiveness, Collect Data and Measure Effectiveness, Identify Dynamics Of Effective Teams, Help Teams Determine Their Own Needs, Foster Effective Team Behaviors, Help Teams Take Action, **Virtual Teams**-Hybrid Work Culture / WFH Culture And Managing Teams in Those Environments. **Case Study:** Team Building In Project Management With Reference to Academic Project Work.	7
V	**Project Monitoring & Control** Introduction, Project Control Cycle, Reporting Structures, Progress Report, Code Review Inspection and Walk-through. Prioritising And Cost Monitoring, Four Steps in Cost Management, Earned Value Analysis, Baseline Budget, Change Control, **Software Configuration Management**-Process, **Tools**-Git, SCCS, RCS **Contract Management**- The Stages, Challenges, Benefits of Contract Management, Types of Contracts. **Case Study:** Online Shopping System, Track Different Versions Of A Software Using Git Tool	6
VI	**Applications of Software Project Management in Industry** **Agile Project Management With Azure Devops:** An Overview Of Application Lifecycle Management & Azure DevOps, Traceability, Visibility, Collaboration, and Extensibility. Microsoft TFS and Azure DevOps. **Metrics In Agile Practice:** Introduction To Metrics in Agile Practice, Agile Project Management In Azure DevOps and TFS. **Site Reliability Engineering (SRE)** - Key Principles, SRE Vs DevOps, Responsibilities and Benefits Of SRE, Root Cause Analysis (RCA), Service Level Agreement (SLA), Role Of GenAI in Software Development. **Case Study:** Student Management System	7
Total Teaching Hours		**39**

List of Tutorials:

1. Plan and manage the development of an Online Shopping System by conducting feasibility analysis and selecting an appropriate SDLC model using Software Project Management principles.

2. For a given problem statement, use an LLM (Gemini/ChatGPT) to generate a Product Requirements Document (PRD). Define the MVP (Minimum Viable Product) features, identify key Stakeholders, and create a User Persona map.

3. Conduct a simulated "Planning Poker" session for the backlog created in Tutorial 1. Categorize tasks using T-Shirt Sizing (XS, S, M, L, XL). Calculate the team's Velocity based on a simulated 2-week Sprint.

4. Perform LOC / Function Point estimation and apply COCOMO model to estimate effort, schedule, and cost on selected projects in tutorial 1.

5. Prepare Work Breakdown Structure for a System. Draw PERT/CPM network and identify critical path.

6. Demonstrate the use of Git commands to manage versions of a software project including add, commit, branch, merge, and push operations.

7. Demonstrate project tracking (EVA), configuration management plan, and define team roles/responsibilities using modern tools (Jira/Trello/MS Project/Azure DevOps).

Text Books:

1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth Edition, Tata McGraw Hill, New Delhi. - (for Unit 1, 3, 5)
2. A Guide to the Project Management Book of Knowledge-Seventh Edition. (For Unit 4)
3. Walker Royce, "Software Project Management" a unified approach. Addison Wesley ISBN 0-20130958-0. (For Unit 6).

Reference Books:

1. JackMarchewka," Information Technology-Project Management", Wiley Student Version, 4th Edition, 2013.
2. Lan Somerville, Software Engineering, Fifth Edition, Addison Wesley Publications, 1996. (For Unit 2)
3. JIM Arlow, Ila Neustadt, UML 2 and the Unified Process, Pearson, Second Edition, ISBN:9788131700549 Tom Pender, UML 2 Bible, Wiley India, ISBN: 9788126504527. (For Unit 2)
4. James P Lewis, "Project Planning, Scheduling & Control", McGraw Hill, 5th Edition, 2011.
5. Pankaj Jalote," Software Project Management in Practice", Pearson Education, 2002.
6. Joachim Rossberg "Agile Project Management with Azure DevOps" Apress. (For Unit 6)

Books / E Learning References:

1. https://www.atlassian.com/agile/product-management/minimum-viable-product(for Unit-1)
2. https://www.ibm.com/think/topics/technical-debt
3. http://managementhelp.org/evaluation/program-evaluation-guide.htm.(For Unit-2)
4. https://predikdata.com/predictive-analytics-for-risk-management(For Unit-2)
5. https://www.ibm.com/think/topics/predictive-analytics(For Unit-2)
6. https://www.inflectra.com/SpiraPlan/(for Unit 3)
7.https://www.techtarget.com/searchsecurity/definition/governance-risk-management-and-compliance-GRC(for Unit 3)
8. https://www.softwaretestinghelp.com/risk-management-tools/#3_Risk_Management_Studio (For Unit 3)
9. https://rework.withgoogle.com/intl/en/guides/understanding-team-effectiveness(For Unit 4)
10. https://www.ibm.com/think/topics/site-reliability-engineering(Unit-6)
11.https://www.tcs.com/what-we-do/industries/high-tech/white-paper/generative-ai-software-development-life-cycle(Unit-6)
12.https://nptel.ac.in/courses/106105218
13.https://onlinecourses.nptel.ac.in/noc26_mg77/preview
14. Virtual Labs:- Software Engineering-
1) http://vlabs.iitkgp.ernet.in/se/3/ **2) http://vlabs.iitkgp.ernet.in/se/5/**
3) http://vlabs.iitkgp.ernet.in/se/6/ **4) http://vlabs.iitkgp.ernet.in/se/7/**

Course Code	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
HS23401	CO1	3	2	2	-	1	-	-	-	1	1	2
	CO2	2	1	-	1	1	-	-	-	-	-	1
	CO3	2	2	-	2	-	-	-	-	-	-	-
	CO4	2	1	2	-	1	-	-	-	-	-	-
	CO5	1	-	-	-	1	-	-	-	1	2	-
	CO6	1	1	-	1	2	-	-	-	-	1	1

Research Methodology and IPR								
Course Code : HS23403			**Course Credits: 04**			**Course type: RM**		
Teaching Scheme			**Evaluation Scheme**					
TH	**PR**	**TUT**	**CAA**	**ISE**	**ESE**	**TW**	**PR**	**OR**
3	**-**	**1**	**30**	**-**	**70**	**30**	**-**	**-**

Prerequisite Course Mapping:
Project based learning of all subjects, Fundamental laws and principles of all subjects, Soft and communication skills.

Course Objectives:
1. The course has been developed with orientation towards research related activities and recognizing the ensuing knowledge as property.
2. It will create consciousness for Intellectual Property Rights and its constituents
3. Learners will be able to perform documentation and administrative procedures relating to IPR in India as well as abroad.

Course Outcomes:
1. Formulate a research problem for engineering and technology domain.
2. Analyze the available literature for given research problem and understand different techniques of data collection.
3. Investigate the statistical and reliability methods of preliminary data analysis and present the results in graphical form.
4. Understand the importance of technical writing and presentation skills.
5. Comprehend the various forms of the intellectual property, its relevance and business impact in the changing global business environment.
6. Realize the importance of patents, trademark and copyright and follow research ethics.

UNIT No.	Syllabus	Hrs
I	**Introduction** Introduction, Meaning of research, Objectives of research, Types of research, Research approaches, Significance of research, Research methods versus methodology, Research and scientific method, Research process, Criteria of good research, Problems encountered in India for good research, Formulation of research hypotheses, Search for causation, Format for research proposal, Funding for the proposal, Different funding agencies, Framework for the planning.	7
II	**Literature Review** Definition of literature and literature survey, Significance of literature survey, Sources of literature, Elements and objectives of literature survey, Styles of literature survey, Strategies of literature survey, Searching the existing literature, Reviewing the selected literature, Writing about the literature reviewed and gap identified, literature analysis, data collection, and interpretation.	6
III	**Preliminary Data Analysis** Testing of hypothesis- concepts and testing, Review of theory of reliability, Hazard models, System reliability. Data presentation skills, Features of statistical analysis, Histogram, bar charts, Pie charts, 2D & 3D plots, Interpolation & extrapolation techniques, Curve fitting.	7
IV	**Technical Writing and Presentation** Effective technical writing, thesis writing, research proposal writing, research paper writing. Significance of report writing, Different steps in writing report, Layout of the research report, Types of reports, Mechanics of writing a research report, Precautions for writing research reports, Presentation skills, tools for technical writing and presentation. Plagiarism, avoiding plagiarism, Research ethics, Tools for plagiarism checking, technical writing and presentation.	7

V	**Intellectual Property Rights** Introduction and significance of intellectual property rights, Types of Intellectual Property Rights, Copyright and its significance, Introduction to patents and its filing, Introduction to patent drafting, Best practices in national and international patent filing, Copyrightable work examples.	6
VI	**Patent Rights** Patents and its basics, Patentable items, Designs, Process of filing patent at national and international level, Process of patenting and development, Technological research and patents, innovation, Patent and copyright international intellectual property, Procedure for grants of patents, Need of specifications, Types of patent applications, Provisional and complete specification, Patent specifications and its contents, Trade and copyright.	6

Text Books :

1. Ranjit Kumar (2005), 2nd edition, Research Methodology: A Step by Step Guide for beginners (Pearson Education).
2. C. K. Kothari (2004), 2nd edition, Research Methodology Methods & Techniques (New Age International, New Delhi).
3. T. Ramappa (2016), 2nd edition, Intellectual Property Rights-Law in India (Asia Law House, Hyderbad).

Reference Books:

1. Louis Cohen, Manion, Morrison and Routledge (2017), 8th edition, Research Methods in Education (Taylor & Francis Group- Cambridge University Press India Pvt. Ltd.).
2. John Best and James Kahn (1998), 8th edition, Research in Education (Prentice Hall of India Pvt. Ltd.).
3. Stuart Melville and Wayne Goddard (2001), Research Methodology: An Introduction for Science and Engineering Students. (Juta & Co Ltd.).
4. Benjamine Niebel and Alan Draper (1974), Product Design and Process Engineering, (McGraw Hill International Publishers).
5. Halbert D. J. (2007), 2nd edition, Resisting Intellectual Property (Taylor and Francis Ltd.).
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley (2016), Intellectual Property in New Technological Age (Stanford Public Law Working Paper No. 2780190, Elsevier Publishers).

Tutorial Task

The term work should consists of following assignments.

1. **Literature Review:** Collect the existing literature on any research idea in engineering/technology and identify the research gap. (Performed in a group of three or four students)

2. **Report and Seminar Presentation:** Prepare a research proposal based on the identified research gap, which may serve as a basis for the project work. The report should be checked for plagiarism and language quality (e.g., using Grammarly or equivalent tools), and the idea should be presented. (Performed in a group of three or four students)

3. **Blank Format of Research Proposal:** Identify national and international funding agencies and prepare/print the blank format of a research proposal of any one agency, for understanding proposal structuring relevant to research work. (Performed in a group of three or four students)

4. **Citation and Referencing Styles:** Write a report on different citation and referencing styles adopted by various publishers, facilitating proper documentation of the research work.

5. **IPR Case Study:** Write a report on a case study of any existing patent/copyright/trademark, providing insight into intellectual property aspects related to project development.

6. **Journal Study:** Collect information on any one peer-reviewed journal and write a report covering abstracting and indexing, H-index, SJR rating, impact factor, aims and scope, and submission guidelines.

Public Speaking and Aptitude								
Course Code : HS23404			**Course Credits: 04**			**Course type: RM**		
Teaching Scheme			**Evaluation Scheme**					
TH	**PR**	**TUT**	**CAA**	**ISE**	**ESE**	**TW**	**PR**	**OR**
1	**-**	**1**	**40**	**-**	**-**	**-**	**-**	**30**

Prerequisite Course Mapping:
Project based learning of all subjects, Fundamental laws and principles of all subjects, Soft and communication skills.

Course Objectives:
1. To develop effective public speaking styles through conversational and communication skills and also enhance speaking skills by focusing on body language and understanding the situational requirements for effective public speaking
2. To develop students' quantitative, logical and analytical abilities required to solve aptitude-based problems commonly encountered in competitive examinations and also enhance their problem-solving speed, decision-making ability and logical reasoning skills
3.

Course Outcomes:

1: Communicate effectively in various public speaking situations and deliver organised and engaging speeches with appropriate body language, voice modulation and confident speech techniques

2**:** Apply appropriate quantitative, logical, and reasoning strategies to efficiently solve numerical aptitude, data interpretation, and logical reasoning problems with improved speed and accuracy in placement and competitive examination contexts and apply rapid analytical, logical and decision-making strategies to solve time-bound problems with improved accuracy and efficiency

UNIT No.	Syllabus	Hrs
I	**Essentials and Art of Public Speaking** Sentence Mastery (Sentence Structure + Subject–Verb Agreement), Verb Tense Control (Past / Present / Future Tenses), Functional Usage (Prepositions + Common Errors & Correct Usage), Verbal & Non-Verbal Communication, Active Listening Skills, Public Speaking & Presentation Skills, Confidence Building, Interpersonal Skills & Relationship Building, Teamwork & Collaboration, Body Language & First Impression, Professional Email, Message & Business Writing, Time Management & Prioritization, Interview Skills & Group Discussion, Workplace Etiquette & Professional Behavior, Emotional Intelligence & Anxiety Control, Stress Management & Work-Life Balance, LinkedIn Profile & Resume Writing, Mock Interviews & Feedback	6
II	**Quantitative Aptitude** Number System, Percentages, Ratio & Proportion, Profit, Loss & Discount, Averages, Time, Speed & Distance, Time & Work + Pipes, Simple & Compound Interest (Basic), Data Interpretation (DI), Data Sufficiency, Seating Arrangement (Linear & Circular), Blood Relations, Coding–Decoding, Syllogisms, Statement–Assumption / Argument.	6

Text Books :

1. King, Dale. Effective Communication Skills: The Nine-Keys Guidebook for Developing the Art of Persuasion through Public Speaking, Social Intelligence, Verbal Dexterity, Charisma, and Eloquence, Hamatea Publishing Studio, 2020
2. King, Patrick. How to Speak Effectively: Master Communication Skills, Public Speaking and Influence | Improve Conversations, Confidence, and Social and Professional Presentations, and Making an Impact on People, Penguin, 2024

3. Tuhovsky, Tuhovsky. Communication Skills: A Practical Guide to Improving Your Social Intelligence, Presentation, Persuasion and Public Speaking: 9 (Positive Psychology Coaching), Createspace Independent Publishing, 2015
4. Aggarwal. R.S., Quantitative Aptitude for Competitive Examinations, S Chand and Company Ltd. 2025

SEMESTER-VIII

Distributed Systems								
Course Code : IT23411			**Course Credits: 04**			**Course type: PCC**		
Teaching Scheme			**Evaluation Scheme**					
TH	**PR**	**TUT**	**CAA**	**ISE**	**ESE**	**TW**	**PR**	**OR**
3	**2**	**-**	**10**	**30**	**60**	**-**	**30**	**-**

Prerequisite Course Mapping:
Prerequisite Course Mapping: Computer Network and Security

Future Course Mapping:
Autonomic Distributed Operating Systems, AI-Driven Networked Distributed Systems.

Course Objectives:
1. To learn the principles, architectures and programming models used in distributed systems.
2. To understand the fundamentals and knowledge of the Middleware of distributed systems.
3. To gain knowledge of working components and fault tolerance of distributed systems.
4. To understand the significance of agreement, fault tolerance and recovery protocols in Distributed Systems.
5. To make students aware about distributed and multimedia file systems and web systems.
6. Create an awareness of Emerging trends in distributed computing.

Course Outcomes:
1. Demonstrate the core concepts of distributed systems.
2. Understand the concept of middleware of distributed systems.
3. Understand Inter-process communication methods and analyze different coordination algorithms.
4. Comprehend the importance of replication to achieve fault tolerance in distributed systems.
5. Analyze the design and functioning of existing distributed file systems, distributed multimedia, and distributed web-based systems.
6. Understand various Recent Trends in distributed systems.

UNIT No.	Syllabus	Hrs
I	**Introduction to Distributed Systems:** Introduction: Network operating System VS Distributed operating systems, Characteristics, Design goals, challenges of Distributed Systems, Examples of Distributed Systems, Trends in Distributed systems: Pervasive networking and the modern Internet, Mobile and ubiquitous computing, Focus on resource sharing Distributed Computing Models: Physical, Architecture and Fundamental models Case Study: WWW 1.0,2.0, 3.0	7
II	**Middleware:** Introduction to middleware, middleware Framework, Role of middleware, Examples of Middleware, Origins of middleware, Architecture vs Middleware, RMI, CORBA, General Approaches to adaptive software, Types of middleware-messages oriented middleware, intelligent middleware, content centric middleware, middleware protocol, middleware Services, Distributed computing Environment (DCE), middleware Issues, middleware Analyst **Case Study: -** XML Based middleware	7
III	**Inter-Process Communication:** IPC: Introduction, Layered protocols, API for internet protocols, IPC through shared memory, external data representation and marshaling, Types of communication, inter process communication, multicast communication, message-oriented communication, MPI, network virtualization, overlay networks Coordination: Clock synchronization, logical clocks, mutual exclusion, election algorithms, Gossip based coordination **Case Study**: IBM WebSphere Message Queuing	7
IV	**Replication and Fault Tolerance : Replication**: Reasons for replication, Replica management – Finding the best server location, Content replication and placement,	6

	Content distribution, Managing replicated objects **Consistency protocols**: Primary based protocols, replicated write protocols **Fault Tolerance**: Introduction to fault tolerance, Reliable client server communication, Reliable group communication, distributed commit, Recovery – Check pointing, Message logging **Case Study**: Caching and replication in web	
V	**Distributed Files, Multimedia and Web Based System :** **Distributed Files**: Introduction, File System Architecture, Sun Network File System and HDFS. **Distributed Multimedia Systems**: Characteristics of Multimedia Data, Quality of Service Management, Resource Management **Distributed Web Based Systems**: Architecture of Traditional Web-Based Systems, Apache Web Server, Web Server Clusters, Communication by Hypertext Transfer Protocol, Synchronization, Web Proxy Caching **Case Study**: The Global Name Service, The X.500 Directory Service, BitTorrent	6
VI	**Recent Trends in Distributed Systems:** **Recent Trends**: Introduction, Portable and handheld Devices, Wearable devices, Devices embedded in appliances, Parallel Virtual Machine (PVM), Jini, Service Oriented Architecture, The Future of Recent Trends. **Tools for Distributed System Monitoring**: Prometheus, Zabbix, Nagios **Case Studies**: Mach, Chorus	6

List of Practical Assignments:

1. Implement multi-threaded client/server Process communication using RPC/RMI.
2. Develop a distributed system, to find sum of N elements in an array by distributing N/n elements to n number of processors MPI or OpenMP. Demonstrate by displaying the intermediate sums calculated at different processors.
3. Implement Berkeley algorithm for clock synchronization.
4. Implement token ring based mutual exclusion algorithm.
5. Implement Bully and Ring algorithm for leader election.
6. Create a simple web service and write any distributed application to consume the web service.
7. **Mini Project (In group):**
   a. A Distributed Application for Interactive Multiplayer Games
   b. Design, implement, and thoroughly test a distributed system, implementing - Shared document editing, in the style of Google docs. The system should support real-time editing and viewing by multiple participants. Multiple replicas would be maintained for fault tolerance. Caching and/or copy migration would be useful to minimize application response time.
   c. Design, implement, and thoroughly test a distributed system, implementing - Implement a distributed file system that does something interesting. Maybe you want one for storing your MP3s or movies. Or perhaps for something entirely different.

Text Books :

1. Distributed Systems: Concepts and Design by George Coulouris, J Dollimore and Tim Kindberg,
2. Pearson Education, ISBN: 9789332575226, 5th Edition, 2017.
3. Distributed Systems, Maarten van Steen, Andrew S. T,ThirdeditionVersion.
4. Andrew S. Tanenbaum, Maarten van Steen, PHI ,2nd Edition, ISBN: 978-0130888938

Distributed Operating Systems: Concepts and Design by P. K. Sinha, PHI, ISBN: 978-0780311190

Reference Books:

1. Distributed Computing, Sunita Mahajan and Seema Shah, Oxford University
2. Distributed Computing, Fundamentals, Simulations and Advanced topics, 2nd Edition,
3. HagitAttiya and Jennifer Welch, Wiley India
4. Tool for Distributed Systems Monitoring, Łukasz KUFEL, Foundation of Computing and Decision Sciences, Vol 41(4), 2016, e-ISSN 2300-3405, DOI:10.1515/fcdc-2016-0014

Online Resources:
1. http://home.mit.bme.hu/~meszaros/edu/oprendszerek/segedlet/elosztott/distributed-systems-survey.pdf
2. http://home.mit.bme.hu/~meszaros/edu/oprendszerek/segedlet/elosztott/DisSysUbiCompReport.html

Course Code	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
IT23411	CO1	3	2	-	-	2	-	-	-	-	-	2
	CO2	3	3	2	1	2	-	-	-	-	-	1
	CO3	3	2	-	2	-	-	-	-	-	-	-
	CO4	3	2	-	2	-	-	-	-	-	-	1
	CO5	-	-	-	-	-	2	1	-	-	-	1
	CO6	-	-	-	-	2	1	-	-	-	-	1

Program Elective IV-A: Cloud Computing

Course Code: IT23412A	Course Credits: 04	Course type: PEC

Teaching Scheme			Evaluation Scheme					
TH	PR	TUT	CAA	ISE	ESE	TW	PR	OR
3	2	-	10	30	60	-	-	30

Prerequisite Course Mapping: 1. Computer Network & Security 2. Database Management System

Future Course Mapping: Cloud Security

Course Objective:

1. Introduce fundamental concepts, evolution, and architecture of cloud computing.
2. Provide knowledge of cloud service models and cloud-based application development.
3. Enable students to use cloud services for collaboration, storage, and enterprise applications.
4. Develop the ability to design cloud architectures using virtualization and disaster recovery techniques.
5. Familiarize students with major public cloud platforms and their service offerings.
6. Create awareness of cloud security issues and defense strategies.

Course Outcomes: On completion of the course, learner will be able to

1. Explain cloud computing concepts, evolution, architecture, and storage mechanisms.
2. Differentiate cloud deployment models and service models.
3. Develop and deploy basic cloud-based applications using public cloud platforms.
4. Use cloud services for collaboration, data sharing, and enterprise productivity.
5. Design cloud architectures incorporating virtualization and disaster recovery.
6. Analyze security challenges and defense strategies in public cloud platforms.

UNIT No.	Syllabus	Hrs
I	**Understanding Cloud Computing** Cloud Computing – Recent trends in Computing, History of Cloud Computing, Cloud Architecture, Cloud Storage, Why Cloud Computing Matters – Advantages of Cloud Computing – Disadvantages of Cloud Computing, Companies in the Cloud Today, Cloud Services.	7
II	**Developing Cloud Services** Web-Based Application, Pros and Cons of Cloud Service Development, Types of Cloud Service Development, Software as a Service, Platform as a Service, Web Services – OnDemand Computing, Discovering Cloud Services Development Services and Tools – Amazon Ec2, Google App Engine – IBM Clouds.	7
III	**Cloud Computing for Everyone** Centralizing Email Communications – Collaborating on Schedules – Collaborating on To-Do Lists – Collaborating Contact Lists – Cloud Computing for the Community – Collaborating on Group Projects and Events – Cloud Computing for the Corporation.	6
IV	**Using Cloud Services** Collaborating on Calendars, Schedules and Task Management – Exploring Online Scheduling Applications – Exploring Online Planning and Task Management – Collaborating on Event Management – Collaborating on Contact Management –	6

	Collaborating on Project Management – Collaborating on Word Processing -Collaborating on Databases – Storing and Sharing Files.	
V	**Cloud Computing and Service Models** Public, Private, and Hybrid Clouds, Cloud Ecosystem and Enabling Technologies, Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS) and Software-asaService (SaaS) Architectural Design of Compute and Storage Clouds A Generic Cloud Architecture Design, Layered Cloud Architectural Development, Virtualization Support and Disaster Recovery, Architectural Design Challenges.	7
VI	**Public Cloud Platforms** GAE, AWS, and Azure Public Clouds and Service Offerings, Google App Engine (GAE), Amazon Web Services 6 (AWS), Microsoft Windows Azure, Cloud Security Defense Strategies.	6
Total Teaching Hours		**39**

List of Practical Assignments:

1: Study of Cloud Computing Models.
2. To study cloud architecture and different cloud storage mechanisms.
3. To develop and deploy a basic web application using cloud services.
4. To study cloud service development types and service models.
5. To launch and manage virtual machines on the cloud.
6. To use cloud tools for email and contact collaboration.
7. To collaborate on documents using cloud services.
8. To store and share files securely on the cloud.
9. To study cloud security threats and defense mechanisms.
10. To study services offered by AWS and Microsoft Azure.

Text Books:

1. Cloud Computing: Principles and Paradigms – Rajkumar Buyya, James Broberg & Andrzej M. Goscinski (Wiley) — widely used in UG/PG courses covering fundamentals, architecture, services and trends.
2. Cloud Computing Concepts and Technologies – Gopal Shyam (CRC Press) — modern treatment of cloud concepts, SLAs, resource management, and virtualization.
3. Distributed and Cloud Computing: From Parallel Processing to the Internet of Things – Kai Hwang, Jack Dongarra & Geoffrey C. Fox (Elsevier/Morgan Kaufmann) — excellent for understanding distributed systems foundations essential for cloud.
4. Cloud Computing: Concepts, Technology & Architecture – Erl, Puttini & Mahmood (Pearson) — comprehensive context for architecture, virtualization, services, and trends.

Reference Books:

1. Mastering Cloud Computing – Rajkumar Buyya, Christian Vecchiola & S. Thamarai Selvi (McGraw Hill).
2. Cloud Computing Bible – Barrie Sosinsky (Wiley India) — good supplemental reference for service models and use cases.
3. Cloud Computing: A Practical Approach – Anthony Velte, Toby Velte & Robert Elsenpeter (McGraw Hill).
4. Cloud Security: A Comprehensive Guide to Secure Cloud Computing – Ronald L. Krutz & Russell Dean Vines (Wiley) — ideal for Unit V & VI topics.
5. Cloud Computing Black Book – Kailash Jayaswal et al. (Dreamtech Press).

Online Resources:
https://onlinecourses.nptel.ac.in/noc25_cs57/preview
https://onlinecourses-archive.nptel.ac.in/noc18_cs44/
https://archive.nptel.ac.in/courses/106/104/106104242/

Course Code	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
IT23412A	CO1	3	2	-	-	-	-		-	-	-	-
	CO2	3	3	2	-	2	-	-	-	-	-	-
	CO3	2	2	3	3	3	-	-	-	-	-	-
	CO4	2	-	2	2	3	-	-	-	2	-	-
	CO5	2	3	3	3	3	-	-	-	-	-	-
	CO6	2	3	2	2	3	2					

Program Elective IV-B: GPU Programming								
Course Code: IT23412B			**Course Credits: 04**			**Course type: PEC**		
Teaching Scheme			**Evaluation Scheme**					
TH	**PR**	**TUT**	**CAA**	**ISE**	**ESE**	**TW**	**PR**	**OR**
3	**2**	**-**	**10**	**30**	**60**	**-**	**-**	**30**

Prerequisite Course Mapping:
1**.** Computer Graphics 2. Logic Design & Computer Organization

Future Course Mapping:
1. High Performance Computing

Course Objective:
1. To Understand Graphics Processing Unit (GPU) Concepts.
2. To understand the basics of GPU architectures.
3. To write programs for massively parallel processors.
4. To understand the issues in mapping algorithms for GPUs.
5. To introduce different GPU programming models.
6. To examine the architecture and capabilities of modern GPUs.

Course Outcomes: On completion of the course, learner will be able to
1. Explain GPU architecture, CUDA execution model, and GPU memory hierarchy.
2. Develop and optimize CUDA programs using threads, blocks, grids, and multi-GPU configurations.
3. Identify and resolve synchronization, memory, and algorithmic issues in GPU programming.
4. Implement parallel programs using OpenCL for heterogeneous computing platforms.
5. Design efficient GPU-based applications for neural network training and inference
6. Implement parallel algorithms such as convolution, prefix sum, sparse matrix, and matrix multiplication on GPUs.

UNIT No.	Syllabus	Hrs
I	**Introduction to Graphics Processing Unit (GPU)** Evolution of GPU architectures, Understanding Parallelism with GPU, Typical GPU Architecture, CUDA Hardware Overview, Threads, Blocks, Grids, Warps, Scheduling Memory Handling with CUDA: Shared Memory, Global Memory, Constant Memory and Texture Memory.	7
II	**Cuda Programming** Using CUDA, Multi GPU, Multi GPU Solutions, Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions.	7
III	**Programming Issues** Common Problems: CUDA Error Handling, Parallel Programming Issues, Synchronization, Algorithmic Issues, Finding and Avoiding Errors.	7
IV	**Opencl Basics** OpenCL Standard, Kernels, Host Device Interaction, Execution Environment, Memory Model, Basic OpenCL Examples.	6
V	**OpenCL and Application Design** OpenCL for Heterogeneous Computing, Application Design: Efficient Neural Network Training/Inferencing.	6

VI	**Algorithms on GPU** Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix – Matrix Multiplication, Programming Heterogeneous Cluster.	6
Total Teaching Hours		**39**

List of Practical Assignments:

01. Study the architecture of a Graphics Processing Unit (GPU).
02. Understand CUDA execution hierarchy.
03. Study CUDA memory hierarchy.
04. Implement a vector addition CUDA program.
05. Implement matrix multiplication to optimize CUDA program performance
06. Understand multi-GPU execution.
07. Identify and handle CUDA runtime errors.
08. Study synchronization issues.
09. Detect algorithmic and logical errors.
10. Execute OpenCL program on different devices.
11. Apply GPU programming to real-world problems.

Text Books:

1. Shane Cook, "CUDA Programming: A Developer's Guide to Parallel Computing with GPUs (Applications of GPU Computing)", First Edition, Morgan Kaufmann, 2012.
2. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, "Heterogeneous computing with OpenCL", 3rd Edition, Morgan Kauffman, 2015.
3. Benedict Gaster, Lee Howes, David R. Kaeli, "Heterogeneous Computing with OpenCL"

Reference Books:

1. Nicholas Wilt, "CUDA Handbook: A Comprehensive Guide to GPU Programming", Addison – Wesley, 2013.
2. Jason Sanders, Edward Kandrot, "CUDA by Example: An Introduction to General Purpose GPU Programming", Addison – Wesley, 2010.
3. David B. Kirk, Wen-mei W. Hwu, "Programming Massively Parallel Processors ", A Hands-on Approach, Third Edition, Morgan Kaufmann, 2016.
4. http://www.nvidia.com/object/cuda_home_new.html
5. http://www.openCL.org

Online Resources:

1. https://archive.nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs41/
2. https://archive.nptel.ac.in/noc/courses/noc21/SEM1/noc21-cs46/
3. https://archive.nptel.ac.in/noc/courses/noc22/SEM1/noc22-cs09/

Course Code	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
IT23412B	CO1	3	2	-	-		-	-	-	-	-	-
	CO2	2	3	3	-	3	-	-	-	-	-	-
	CO3	2	3	2	3	-	-	-	-	-	-	-
	CO4	2	2	3	-	3	-	-	-	-	-	-
	CO5	2	3	3	2	3	1	1	-	-	-	2
	CO6	2	3	3	3	3	-	-	-	-	-	-

Program Elective IV-C :Information Retrieval Systems								
Course Code : IT23412C			**Course Credits: 04**			**Course type: PEC**		
Teaching Scheme			**Evaluation Scheme**					
TH	**PR**	**TUT**	**CAA**	**ISE**	**ESE**	**TW**	**PR**	**OR**
3	**2**	**-**	**10**	**30**	**60**	**-**	**-**	**30**

Prerequisite Course Mapping:

1. Data Structures and Algorithms, Data Base Management Systems

Future Course Mapping:

1. Intelligent Information Retrieval.
2. Distributed Retrieval.

Course Objective:

1. To gain a clear understanding of the fundamental principles and models of information retrieval.
2. To study the importance and application of clustering techniques in organizing and retrieving information.
3. To explore various indexing methods and search algorithms used for efficient information access.
4. To analyze techniques for evaluating information retrieval systems and to understand the design of effective search user interfaces.
5. To understand mechanisms and technologies that support information sharing over the web.
6. To examine real-world applications of information retrieval, with special emphasis on multimedia retrieval, distributed information retrieval, and web search systems.

Course Outcomes: On completion of the course, learner will be able to

1. Understand the basic ideas of information retrieval and apply clustering to organize information.
2. Implement appropriate indexing techniques for the retrieval of text and multimedia information.
3. Analyze and evaluate the performance of information retrieval systems using standard metrics.
4. Apply concepts of multimedia and distributed information retrieval in practical scenarios.
5. Analyze web-based information using suitable tools and techniques.
6. Design and simulate the functioning of search engines and recommender systems.

Unit No.	Syllabus	Hrs
I	**Introduction to Information Retrieval** Basic Concepts of IR, Data Retrieval & Information Retrieval, Text mining and IR relation, IR system block diagram, Automatic Text Analysis: Luhn's ideas, Conflation Algorithm, Indexing and Index Term Weighting, Probabilistic Indexing, Automatic Classification. Measures of Association, Different Matching Coefficients, Cluster Hypothesis, Clustering Techniques: Rocchio's Algorithm, Single pass algorithm, Single Link algorithm.	**7**
II	**Indexing and Searching Techniques** Indexing: Inverted file, Suffix trees & suffix arrays, Signature Files, Scatter storage or hash addressing. Searching Techniques: Boolean Search, sequential search, Serial search, cluster-based retrieval, Query languages, Types of queries, Patterns matching, structural queries. IR Models: Basic concepts, Boolean Model, Vector Model, Probabilistic Model.	**7**
III	**Evaluation and Visualization of Information Retrieval System** Performance Evaluation: Precision and recall, MRR, F-Score, NDCG, user-oriented measures. Visualization in Information System: Starting points, Query Specification, document context, User relevance judgment, Interface support for search process.	**7**
IV	**Distributed and Multimedia IR**	6

	Distributed IR: Introduction, Collection Partitioning, Source Selection, Query Processing. Multimedia IR: Introduction, Data Modeling, Query Language, Background-Spatial Access Method, A Generic Multimedia Indexing Approach, One Dimensional Time Series, Two-Dimensional color Images, Automatic Feature Extraction, Trends and Research Issue.	
V	**Web Searching** Introduction, Challenges, Web Characteristics, Search Engines: Centralized Architecture, Distributed Architecture, User Interfaces, Ranking, Crawling the web, Indices, Browsing, Meta-searchers, Searching using Hyperlinks, Trends and Research Issues, Introduction to Web Scraping: Python for web scraping, Request, HTML parsing, Beautiful Soup.	6
VI	**Advanced Information Retrieval** XML Retrieval: Basic XML concepts, Challenges in XML retrieval, Vector space model for XML retrieval, Evaluation of XML retrieval, Text-Centric vs. Data-Centric XML retrieval. Recommendation System: Collaborative Filtering and Content Based Recommendation of Documents and Products. Introduction to Semantic Web.	6
Total Teaching Hours		**39**

List of Laboratory Assignments(Java/Python):-

1. Design and implement a conflation algorithm to process a text file and generate its document representative by reducing words to their root forms.
2. Develop a single-pass clustering algorithm to group 4 to 5 text files based on their content similarity.
3. Implement a document retrieval system using inverted file indexing to efficiently search and retrieve relevant documents.
4. Implement a program to calculate precision and recall for sample input.
5. Write a program to calculate harmonic mean (F-measure) and E-measure.
6. Develop a program to extract features from a 2D color image and display the feature distribution using histograms.
7. Create a web crawler to fetch product data and links from an e-commerce site.
8. Study and analyze the design and working of a recommender system for recommending products, doctors, prices, or music.

Text books:

1. David A. Grossman, OphirFrieder, Information Retrieval – Algorithms and Heuristics, Springer, 2nd Edition(Distributed by Universal Press), 2004.

Reference books

1. Gerald J Kowalski, Mark T Maybury Information Storage and Retrieval Systems: Theory and Implementation, Springer, 2004.
2. SoumenChakrabarti, Mining the Web : Discovering Knowledge from Hypertext Data, Morgan – Kaufmann Publishers, 2002.
3. Christopher D Manning, PrabhakarRaghavan, HinrichSchutze, An Introduction to Information Retrieval By Cambridge University Press, England, 2009.

Online Resources:

1. **https://onlinecourses.nptel.ac.in/noc26_cs13/preview**
2. **https://nptel.ac.in/courses/106106852**
3. http://nlp-iiith.vlabs.ac.in/

Course Code	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
IT23412C	CO1	3	-	-	-	2	1	1	-	1	-	-	-
	CO2	2	1	2	1	2	-	-	-	-	-	-	-
	CO3	2	2	1	1	1	-	-	-	-	-	-	-
	CO4	2	1	1	1	2	1	-	-	-	-	-	1
	CO5	2	1	-	-	2	-	-	-	-	-	1	1
	CO6	2	-	1	-	1	-	-	1	1	1	1	1

Program Elective V-A: Mobile Computing								
Course Code : IT23413A			**Course Credits: 03**			**Course type: PEC**		
Teaching Scheme			**Evaluation Scheme**					
TH	**PR**	**TUT**	**CAA**	**ISE**	**ESE**	**TW**	**PR**	**OR**
2	**2**	**-**	**10**	**-**	**60**	**-**	**-**	**30**

Prerequisite Course Mapping:
1. Computer Networks

Future Course Mapping:
1. AI driven mobile computing system.

Course Objective:
1. To understand the basic concepts of mobile computing.
2. To learn the basics of mobile telecommunication system.
3. To understand the Generations of Mobile Communication Technologies.
4. To be familiar with the network layer, transport layer and application layer protocols.

Course Outcomes: On completion of the course, learner will be able to
1. Understand the basic concepts of mobile computing, MAC and different multiplexing technics
2.Understand Protocols, Connection Establishment, Frequency Allocation, Routing of mobile telecommunication system like GSM, GPRS, UMTS.
3. Understand the Generations of Mobile Communication Technologies
4. Gain knowledge of mobile IP , Adhoc Network, Reactive Routing protocols, Transport Layer and Application Layer Protocols.

Syllabus

UNIT No.	Syllabus	Hrs
I	**Introduction** Introduction to Mobile Computing: Applications of Mobile Computing, A short history of wireless communication. Medium Access Control: Motivation for a specialized MAC, Hidden and Exposed terminals. Near and Far terminals. SDMA, FDMA, TDMA: Fixed TDM, Classical Aloha, Slotted Aloha, Carrier sense multiple access, Demand assigned multiple access, PRMA packet reservation multiple access, Reservation TDMA, Multiple access with collision avoidance, Polling, Inhibit sense multiple access. CDMA: Spread Aloha multiple access.	7
II	**Mobile Telecommunication System** Introduction to Cellular Systems, GSM: Services &Architecture, Protocols, Connection Establishment, Frequency Allocation, Routing, Mobility Management, Security, GPRS, UMTS: Architecture, Handover, Security.	6
III	**Generations of Mobile Communication Technologies** First Generation Wireless Networks, Second Generation (2G) Wireless Cellular Networks, Major 2G standards, 2.5G Wireless Networks, Third Generation 3G Wireless Networks, Fourth Generation 4G wireless networks, Fifth Generation 5G wireless networks	6
IV	**Mobile Network Layer and Mobile Transport Layer** Mobile IP: Goals, assumptions and requirements, Entities and Terminology, IP packet delivery, Agent advertisement and discovery, Registration, Tunnelling and Encapsulation, Optimizations, Reverse tunnelling. IPv6: DHCP. AdHoc networks: Routing, Proactive protocol-DSDV. Reactive Routing Protocols: DSR, AODV, Vehicular Ad Hoc networks	7

	(VANET), MANET. Traditional TCP: Congestion control, Slow start, Fast retransmit/fast recovery, Implications on mobility, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission/time-out freezing, Selective retransmission, Support for Mobility, WWW: HTTP protocol, Wireless System Architecture. Wireless application protocol: Wireless datagram protocol, Wireless transaction protocol, Wireless session protocol, Wireless application environment.	
Total Teaching Hours		**26**

List of Practical Assignments:

1. Study of mobile operating systems (Android, iOS, Windows Mobile).
2. Study of GSM, CDMA, LTE, 4G and 5G technologies
3. Study of cellular network architecture.
4. Develop an Android app for student information (name, roll no, marks).
5. Develop an app to display current location using GPS.
6. Study of mobile authentication methods (PIN, Biometrics).
7. Study of mobile payment systems (UPI, Google Pay, Paytm).

Text Books:

1. Yi Bang lin ,“Wireless and mobile Network Architectures" Wiley publications
2. William c.y. Lee, "Mobile Communications and Design Fundamentals" Wiley publications

Reference Books:

1. Jochen Schiller, “Mobile Communications”, PHI, Second Edition, 2003.
2. Prasant Kumar Pattnaik, Rajib Mall, “Fundamentals of Mobile Computing”, PHI Learning Pvt.Ltd, New Delhi – 2012
3. C.K.Toh, “AdHoc Mobile Wireless Networks”, First Edition, Pearson Education, 2002.
4. “Principles of Mobile Computing”, 2nd Edition, Uwe Hansmann, LotharMerk, Martin Nicklous, Thomas Stober, Springer
5. “Mobile Computing”, Tomasz Imielinski, Springer

Online Resources:

1) https://nptel.ac.in/courses/106106147

Course Code	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
IT23413A	CO1	2	2	-	-	2	-	-	-	-	-	-
	CO2	2	3	2	-	2	-	-	-	-	-	-
	CO3	2	2	-	-	1	-	-	-	-	-	-
	CO4	2	3	2	2	3	2	-	2	-	-	-

Program Elective V-B: Blockchain Technology								
Course Code:IT23413B			**Course Credits: 03**			**Course type: PEC**		
Teaching Scheme			**Evaluation Scheme**					
TH	**PR**	**TUT**	**ACTIVITY**	**ISE**	**ESE**	**TW**	**PR**	**OR**
2	**2**	**-**	**10**	**-**	**60**	**-**	**-**	**30**

Prerequisite Course Mapping:

1. Computer Networks, Cryptography Basics,.
2. Distributed Systems

Future Course Mapping: Advanced Cryptography

Importance of Course: Students will able to learn concepts in Blockchain

Course Objectives:

1. To understand the fundamentals of blockchain technology and distributed ledger systems.
2. To learn cryptographic techniques used in blockchain systems.
3. To understand consensus mechanisms and blockchain architecture.
4. To explore cryptocurrency platforms such as Bitcoin and Ethereum.

Course Outcomes:

1. Explain block chain architecture, distributed ledgers, and decentralization concepts.
2. Apply cryptographic techniques such as hashing and digital signatures in blockchain systems.
3. Analyze different consensus mechanisms and blockchain protocols.
4. Understand cryptocurrency systems such as Bitcoin and Ethereum.

Syllabus

Unit No.	Syllabus	Hrs
I	**Introduction to Blockchain Technology** Evolution of block chain, Distributed ledger technology, Traditional centralized vs decentralized systems, Block chain architecture and components, Blocks, transactions, hash functions, Types of block chain: Public, Private, Consortium, Advantages and limitations of block chain	6
II	**Cryptographic Foundations** Cryptography basics for blockchain,Hash functions (SHA-256),Public key cryptography.Digitalsignatures.Merkletrees.Walletsand addresses. Blockchain security principles	6
III	**Consensus Mechanisms** Distributed consensus problem, Byzantine Fault Tolerance,Proof of Work (PoW),Proof of Stake (PoS),Delegated Proof of Stake, Practical Byzantine Fault Tolerance Mining and incentives	7
IV	**Bitcoin and Cryptocurrency** Bitcoin architecture,Bitcoin transactions and scripts,Bitcoin blocks and blockchain,Mining process,Double spending problem,Bitcoin wallets, Cryptocurrency ecosystem	7
Total Teaching Hours		**26**

List of Practical Assignments:

1. Study and compare centralized vs decentralized systems using diagrams.
2. Implement SHA-256 hashing using Python.
3. Simulate Merkle Tree generation for transaction verification.
4. Analyze the structure of a Bitcoin block using blockchain explorer.
5. Create a simple crypto currency transaction model using Python.

Text Books-

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press, 2016.
2. Imran Bashir, Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained, Packt Publishing, 3rd Edition, 2020.
3. Chandramouli Subramanian, Asha A. George, Abhilash K. A. and Meena Karthikeyan, Blockchain Technology: Concepts and Applications, University Press (India), 2021.
4. Daniel Drescher, Blockchain Basics: A Non-Technical Introduction in 25 Steps, Apress, 2017.

Reference Books-

1. Andreas M. Antonopoulos, Mastering Bitcoin: Programming the Open Blockchain, O'Reilly Media, 2nd Edition, 2017.
2. Andreas M. Antonopoulos and Gavin Wood, Mastering Ethereum: Building Smart Contracts and DApps, O'Reilly Media, 2018.
3. Don Tapscott and Alex Tapscott, Blockchain Revolution: How the Technology Behind Bitcoin Is Changing Money, Business, and the World, Portfolio, 2016.
4. Melanie Swan, Blockchain: Blueprint for a New Economy, O'Reilly Media, 2015.
5. Josh Thompson, Blockchain: The Blockchain for Beginners – Guide to Blockchain Technology and Blockchain Programming, CreateSpace Independent Publishing Platform, 2017

Online Resources:

1. NPTEL Course: Blockchain Architecture Design and Use Cases, IIT Kharagpur.
2. NPTEL Course: Blockchain and its Applications, IIT Madras.
3. SWAYAM / NPTEL: Blockchain Technology and Applications.
4. Ethereum Developer Documentation – https://ethereum.org
5. Hyperledger Documentation – https://www.hyperledger.org

Program Elective V-C: Natural Language Processing								
Course Code : IT23413C			**Course Credits: 03**			**Course type: PEC**		
Teaching Scheme			**Evaluation Scheme**					
TH	**PR**	**TUT**	**CAA**	**ISE**	**ESE**	**TW**	**PR**	**OR**
2	**2**	**-**	**10**	**-**	**60**	**-**	**-**	**30**

Prerequisite Course Mapping:
1. Theory of Computation
2. Python for Data Science

Future Course Mapping:
1. Deep Learning

Course Objective:
1. Learn the importance of natural language modelling
2. Study spelling, error detection and correction methods and parsing techniques in NLP
3. Calculate the test similarity using various NLP Approach
4. Understand the Applications of natural language processing

Course Outcomes: On completion of the course, learner will be able to
1. **Discuss** the emerging trends and challenges in NLP and perform the basic NLP tasks using some NLP library.
2. **Apply** regular expressions for data cleaning and Analyse the syntax analysis for word level- in NLP.
3. **Evaluate** similarity in text data and discuss the text representation in sematic.
4. **Apply** advanced techniques like sequential modelling and attention mechanism to develop NLP applications

Syllabus

UNIT No.	Syllabus	Hrs
I	**Introduction to Natural Language Processing** Definition, Applications, Challenges and emerging trends in NLP, NLP Applications Information Retrieval **NLP tasks using NLTK:** Tokenization, stemming, lemmatization, stop-word removal, POS tagging, Parsing, Named Entity Recognition, Term Frequency and Inverse Document Frequency (TF-IDF).	7
II	**Syntax Analysis** Linguistic foundations: Morphology, syntax, semantics and pragmatics, N-grams Model. **Word Level Analysis:** Regular Expressions, Finite-State Automata, Morphological Parsing, Spelling Error Detection and Correction, Words and Word Classes. **Syntactic Analysis:** Context-Free Grammar, Probabilistic Context Free Grammar Constituency, Parsing Natural Language	7
III	**Sematic & Text Analysis** Meaning Representation, Lexical Semantics, Ambiguity, Word Sense Disambiguation, Textual Similarity: Cosine similarity, Word Mover's distance, Word Embedding: Word2Vec, GloVe, FastText	6
IV	**Advanced NLP Techniques** Sequential data, Transformer-based models: BERT, GPT, T5, Introduction to Hugging Face Transformers, Pretrained Bi-LSTMs:ELMO. **Large Language Model:** In-context Learning, Scaling Laws, Parameter Efficient Fine-tuning(PERT)-LoRA,QLoRA	6
Total Teaching Hours		**26**

List of Practical Assignments:

1. Write a Python program for the following preprocessing of text in NLP:
    - Tokenization
    - Filtration
    - Script Validation
    - Stop Word Removal
    - Stemming
2. Write a python program for
    - Analyze grammatical structure of sentences using POS tagging and syntax parsing.
    - Named Entity Recognition and Information Extraction
3. Write a python program for
    - Perform morphological analysis and spelling error detection
    - Evaluate similarity between documents using vector space models.
4. Write a python program to build unigram, bigram, and trigram models and analyze probability distributions.
5. Write a Python program to find synonyms and antonyms of the word "active" using WordNet.
6. Mini Project-Build an application for
    - Text summarization using BERT,GPT,T5 for English language
    - Classifier using RNN,LSTM, XLNet for English language

Text Books:

1. Daniel Jurafsky, James H. Martin, “Speech and Language Processing”, Second Edition, Pearson Education, 2009 ISBN 0131873210.
2. James Allen, Natural Language Understanding, 2nd edition, 1995 Pearson Education ISBN 13:9780805303346.
3. Akshar Bharti, Vineet Chaitanya and Rajeev Sangal, NLP: A Paninian Perspective,1st edition1995, Prentice ISSBN 9788120309210
4. Tanveer Siddiqui, U.S. Tiwary, “Natural Language Processing and Information Retrieval”,Oxford University Press.
5. Daniel Jurafsky, James H. Martin, “Speech and Language Processing, An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Pearson Education, 2023.

Reference Books:

1. Christopher D. Manning and Hinrich Schutze, “Foundations of Statistical Natural Language Processing” ,MIT Press, 1999 Second Edition, ISBN No. 0-262-13360-l.
2. T. Winograd, Language as a Cognitive Process, 1st edition, 1983 Addison- Wesley ISBN 020108-571-2
3. L.M. Ivansca, S. C. Shapiro, Natural Language Processing and Knowledge Representation, 2nd edition, 2000 AAAI Press ISBN-13: 978-0262590211
4. T V Geetha, “Understanding Natural Language Processing – Machine Learning and Deep Learning Perspectives”, Pearson, 2024.
5. Gerald J. Kowalski and Mark.T. Maybury, “Information Storage and Retrieval systems”,Kluwer Academic Publishers

Online Resources:

1. https://www.youtube.com/watch?v=M7SWr5xObkA
2. https://youtu.be/02QWRAhGc7g
3. https://www.youtube.com/watch?v=CMrHM8a3hqw
4. https://onlinecourses.nptel.ac.in/noc23_cs45/preview
5. https://archive.nptel.ac.in/courses/106/106/106106211/
6. https://www.coursera.org/learn/python-text-mining
7. https://www.coursera.org/learn/nlp-sequence-models

Course Code	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
IT23413C	CO1	3	2	1	1	1	1	-	1	1	-	1
	CO2	3	2	1	1	2	1	-	-	-	-	1
	CO3	2	2	1	-	1	-	-	1	-	-	1
	CO4	2	2	1	1	3	-	1	2	1	1	2

Project

Course Code : IT23414	Course Credits: 4	Course type: PROJ

Teaching Scheme			Evaluation Scheme					
TH	PR	TUT	CAA	ISE	ESE	TW	PR	OR
-	8	-	-	-	-	80	-	50

Prerequisite Course Mapping:
Data Structure , DBMS, Software Engineering, Basic Knowledge of Latest Technologies in IT

Course Objectives:

1. To enable students to identify and solve real-world engineering problems using appropriate tools and technologies.
2. To develop the ability to investigate, analyze and define engineering problems
3. To design and implement a system using appropriate tools, technologies and methodologies.
4. To expose students to product development environment using industrial experience, use of state of art technologies
5. To encourage and expose students to funding agencies for sponsored projects.
6. To improve overall communication skill, Teamwork and Leadership Qualities, professionalism.
7. To analyze performance results and justify selected technologies/algorithms
8. To understand ethical, legal, security and societal implications of IT solutions
9. To improve communication skills through technical report writing and presentation.

Course Outcomes:

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

1. Formulate a real-world engineering problem using mathematical, scientific and domain knowledge based on literature survey and feasibility analysis.
2. Analyze requirements and design a complete system architecture using appropriate models, UML/DFD diagrams and technical specifications.
3. Develop and implement system using modern engineering tools, frameworks, and technologies.
4. Test, validate, and evaluate system performance using appropriate metrics, experimental design, and result analysis techniques.
5. Apply project management principles including planning, scheduling, risk analysis.
6. Demonstrate teamwork, responsibility, leadership.
7. Communicate technical solutions effectively through presentation and report writing, considering ethical and societal impact.

Introductory Information:

Project can be application oriented and/or will be based on some innovative work in recent technologies like Artificial Intelligence / Machine Learning , Computer Vision, Cyber security, IoT / Embedded Systems, Cloud Computing, Web / Mobile Applications, Data Science, Blockchain, Networking, Healthcare /Agriculture / Smart Systems, Natural Language Processing, Theoretical Computer Science fundamentals.

The student will undertake a project which will involve the analysis, design of a system or sub system in the area identified earlier in the field of Information Technology and Computer Science and Engineering. The project will be undertaken preferably by a group of 3-4 students who will jointly work and implement the project. The group will select a project based on their internship or Guide can suggest based on recent technologies / Industrial Applications.

Guidelines to Faculty and Students:

1) The Head of the department / Project coordinator shall constitute a review committee for project group; project guide would be one member of that committee by default.
2) For sponsored projects, an employee of the sponsoring organization may be one of the member of review committee.

3) There shall be Two reviews in a semester.
4) The Project Review committee will be responsible for evaluating the timely progress of the projects.
5) Student should identify project of enough complexity, which has at least 4-5 major functionalities.
6) Student should adopt skills learned in Software Engineering / Software Architecture to identify stakeholders, actors, Architectural Styles etc. and write detail problem statement for the system
7) Review committee should finalize the scope of the project.
8) Every student of the project group shall make presentation on the progress made by them before the
committee during each review. Each student/group is required to give presentation as part of review followed by a detailed discussion and query session.
9) Students need to note down the queries raised during review(s) and comply the same in the next review session.
10) The record of the remarks/suggestions of the review committee (project dairy) should be properly maintained and should be made available at the time of examination.
11) Project group needs to present / publish TWO papers. Paper must be checked for Plagiarism by any open software.
12) Project report must also be checked for plagiarism.
13) The examinee will be assessed by a panel of examiners of which one is necessarily an external examiner. The assessment will be broadly based on work undergone, content delivery, presentation skills, documentation, question-answers, and report

Review 1: Design and Planning

Topics to be Covered:

1) Problem Identification & Background: The precise problem statement/title based on literature survey, motivation, Industry / Societal relevance, feasibility study and scope of the project
2) Literature Review: Existing systems / research work, Comparison of approaches, Identified limitations
3) Requirement Analysis: Functional requirements, Non-functional requirements, Constraints System Design: Architecture diagram, Data flow diagrams, UML diagrams (Use case, Class, Sequence etc.)
4) System overview- proposed system and expected outcomes.
5) Technology Stack Justification: Tools & technologies selected, Justification for chosen method
6) Project Planning: Timeline (Gantt chart), Module division among team members, Risk analysis
1) Expected Outcomes: Performance parameters, Evaluation criteria

Review 2: Requirement and Design Specification, implementation and Result Analysis

1) Users, System, functional and nonfunctional requirements
2) SRS as per problem statement
3) Requirement Analysis
4) Coding
5) Result Analysis

Evaluation Criteria:

Following criteria is suggested for evaluation of Project Term Work.

Problem Definition & Literature Review	10 Marks
System Design (SRS, UML, Architecture)	15 Marks
Implementation	20 Marks
Testing, Validation & Result Analysis	10 Marks
Documentation Quality	10 Marks
Presentation	05 Marks
Question/Answers	05 Marks
Innovation / Industrial Relevance	05 Marks
Total	80 Marks

Project report contains the details as Follows:

I. Certificate from the institute.
II. Certificate sponsoring organization (If any).
III. Acknowledgement.
IV. Abstract.
V. List of Abbreviations (As applicable).
VI. List of Figures (As applicable).
VII. List of Graphs (As applicable).
VIII. List of Tables (As applicable).

1) Introduction and aims/motivation and objectives.
2) Literature Survey (with proper citation).
3) Problem Statement/definition.
4) Software Requirement Specification (In SRS Documentation only).
5) Flowchart
6) Project Requirement specification.
7) Proposed system Architecture.
8) High level design of the project (DFD , UML , ER Diagrams).
9) System implementation-code documentation: Algorithm style, Description of detailed methodologies, protocols used etc..as applicable.
10) Test cases.
11) GUI/Working modules and Experimental Results in suitable format.
12) Project Plan.
13) Analysis and Conclusions with future work.
14) Bibliography in IEEE format.

Appendices

1) Plagiarism Report of Paper and Project report from any open source tool.
2) Base Paper(s) [If any].
3) Tools used / Hardware Components specifications [If any].
4) Published Papers and Certificates (Both Papers).

Use appropriate plagiarism tools, reference managers, Latex for efficient and effective project writing.

Course Code	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
IT23414	CO1	3	3	2	2	1	-	-	-	-	-	-
	CO2	2	3	3	2	2	-	-	-	-	-	1
	CO3	2	2	3	2	3	-	-	-	1	-	1
	CO4	1	2	2	3	2	-	-	-	-	-	-
	CO5	1	2	2	2	2	-	-	-	2	-	3
	CO6	-	-	-	-	-	3	1	3	3	2	2
	CO7	-	-	-	-	-	3	2	3	2	3	2