JHARKHAND Rai University RANCHI

B. TECH (CSE)

Syllabus

Academic Year: 2025-2029 onwards

Vision

To develop the Department of Computer Science & Information Technology as a Center for Excellence to produce leading Professionals who can serve the society with innovative skills, Computer Experts, Researchers to meet the needs of the software industry in national /global scenario responding to the challenges of ever changing world.

Mission

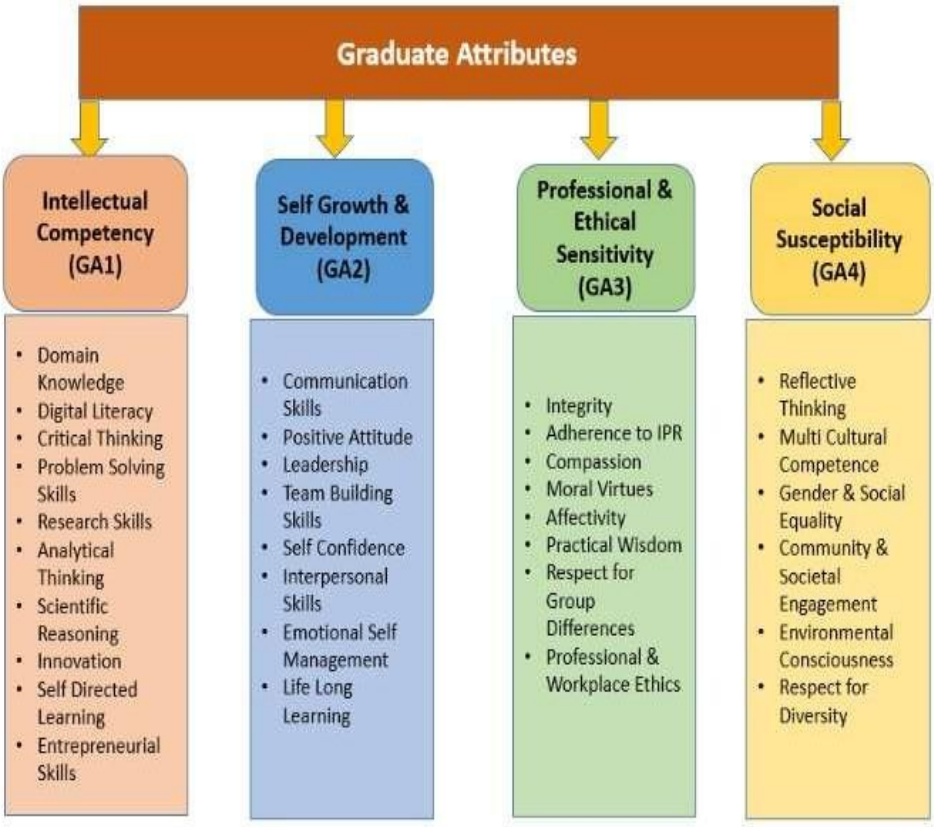
- We endeavor to provide the best possible learning environment to enhance innovations, research capabilities, problem solving skills, leadership qualities, team spirit and ethical responsibilities.
- To nurture the talent of the students to be successful, ethical and effective problem solvers who will contribute positively to the economic growth of the nation and prepare to respond to the challenges.

Graduate Attributes

Jharkhand Rai University is a mecca of transformative education which strongly believes in the holistic development of students. The university provides the cutting-edge of holistic learning to develop promising youngsters into leaders of tomorrow with globally relevant, future-ready and actionable intelligence. The objective of the Department is to make each student proficient in synthesizing/analysing information and be ethical, socially responsible, and just when making decisions. JRU ensures inclusive and equitable quality education and promote lifelong learning opportunities for all.

Every graduate of the Department will be developed to possess the following attributes:

1. Intellectual Competency
2. Self-Growth & Development
3. Professional & Ethical Sensitivity
4. Social Susceptibility



Program Educational Objectives (PEOs)

PEOs (Program Educational Objectives) relate to the career and professional accomplishments ofpassed out students after their graduation from the program. However, keeping the significanceof contribution of the curriculum and the assessment opportunities such as examination and evaluation results, placement data, employer feedback and higher education entrance performance etc. are taken as tools for supplementary evidence to assess PEOs.

The program educational objectives of the undergraduate program in Computer Science Engineering take into consideration the university mission and the constituents‟ needs by producing graduates who will be able to:

- **PEO1:** Develop foundational knowledge, technical skills and competency related to the various core and related areas of IT and ITeS in order to demonstrate good analytical, design and implementation skills.
- **PEO2:** Establish their career in Creativity & Design of Computer Support Systems and impart knowledge and skills with proficiency in analysis, design, coding, testing,deployment, maintenance of the system and application software.
- **PEO3:** Communicate effectively, recognize and incorporate societal needs and constraints intheir professional endeavors, and practice their profession with high regard to ethical responsibilities.
- **PEO4:** Drive scientific and societal advancement through technological innovation and entrepreneurship.
- **PEO5:** Recognize the need for adapting to change & engage themselves in independent life-long learning.

Program Outcome (POs)

Engineering Graduates will be able to:

- **PO1: Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **PO2: Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **PO3: Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **PO4: Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **PO5: Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **PO6: The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **PO7: Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **PO8: Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **PO9: Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

- **PO10: Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **PO11: Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one‟s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- **PO12: Life-long learning**: Recognize the need for, and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSOs)

The students shall have the

- **PSO1: Professional Skills:** Ability to understand, analyze and develop computer programs/ application software in the areas related to Software Engineering, Web and Mobile Application, Artificial Intelligence, Cyber Security & Networking and Data Analysis.
- **PSO2: Problem Solving Skills:** Ability to apply and implement standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.
- **PSO3: Successful Career:** Ability to become employable in a variety of IT companies and government sectors and for the betterment of an individual and society at large.
- **PSO4**: **Entrepreneurship:** Preparedness to adopt new technology with unprecedented ideas to be a successful entrepreneur or zest for higher studies.

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Mapping between PEO and PSO

Program Specific Outcome (PSO)	Program Educational Objective (PEO)				
	PEO1	PEO2	PEO3	PEO4	PEO5
PSO1	High				
PSO2	High	Medium		Low	Low
PSO3			Medium		Medium
PSO4	Medium	Low		Medium	

Mapping of PEO and PO

Program Outcome (PO)	Program Educational Objective (PEO)				
	PEO1	PEO2	PEO3	PEO4	PEO5
PO1	High			Medium	Low
PO2	Medium			Low	Medium
PO3		High			
PO4		Medium			
PO5			Low		
PO6		Medium	Low		
PO7		Medium	Medium	Low	
PO8			High		
PO9	Medium			Low	Medium
PO10	Low		High		
PO11			Medium	Medium	
PO12		Medium			High

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COURSE SCHEME

BATCH 2025-2029

BTECH IN COMPUTER SCIENCE & ENGINEERING

As per the guidelines of NEP 2020 with Multiple Entry and Exit option

SEMESTER I

S. No	NSQF/ NATIONAL CREDIT FRAMEWORK NCrF CREDIT LEVEL	BROAD CATEGORY	CATEGORY	CODE	COURSE TITLE	Periods			Evaluation Scheme				Subject Total	Credit
						L	T	P	Assignment	TA	Total	ESE		
1	4.5	Basic ScienceCourse	Multidisciplinary Course (MDC)	3BSC101	Physics	3	1	0	20	10	30	70	100	4
2		Basic ScienceCourse	Core Course (CC)-Minor	3BSC102	Mathematics I	3	1	0	20	10	30	70	100	4
3		Engineering ScienceCourse	Core Course (CC)-Minor	3ESC101	Basic Electrical Engineering	3	1	0	20	10	30	70	100	4
4		Engineering Science Course	Core Course (CC)-Minor	3ESC102	Engineering Graphics & Design	2	0	0	20	10	30	70	100	2
5		Humanities andSocial Sciences	Ability Enhancement Courses (AEC)	3HSMC101	English	3	0	0	20	10	30	70	100	3
PRACTICAL /SESSIONAL														
1	4.5	Basic Science Course	Skill Enhancement Course (SEC)	3BSC101P	Physics Lab	0	0	2			30	20	50	1
2		Engineering Science Course	Skill Enhancement Course (SEC)	3ESC101P	Basic Electrical Engineering Lab	0	0	2			30	20	50	1
3		Engineering Science Course	Skill Enhancement Course (SEC)	3ESC102P	Engineering Graphics & Design Lab	0	0	2			30	20	50	1
											TOTAL		650	20

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SEMESTER II														
S.No.		**BROAD CATEGORY**	**CATEGORY**	**CODE**	**COURSE TITLE**	**Periods**			**Evaluation Scheme**				**Subject Total**	**Credit**
						L	**T**	**P**	**Assignment**	**TA**	**Total**	**ESE**		
1	4.5	Basic ScienceCourse	Multidisciplinary Course (MDC)	3BSC103	Chemistry	3	1	0	20	10	30	70	100	4
2		Basic ScienceCourse	Core Course (CC)- Minor	3BSC104	Mathematics II	3	1	0	20	10	30	70	100	4
3		Engineering ScienceCourse	Core Courses (CC)- Major	3ESC103	Programming for Problem Solving	3	0	0	20	10	30	70	100	3
4		Engineering ScienceCourse	Skill Enhancement Course (SEC)	3ESC105	Computer Assembly and Repair	1	0	0	20	10	30	70	100	1
5		Mandatory Course	Value Added Course (VAC)	3MC101	Environmental Science	3	0	0	20	10	30	70	100	3
6		Value Added Course	Value Added Course (VAC)	3VAC101	Character Building & Holistic Development of Personality -I (Spiritual & Mental Health)	2	0	0	20	10	30	70	100	2
PRACTICAL /SESSIONAL														
1	4.5	Basic ScienceCourse	Skill Enhancement Course (SEC)	3BSC103P	Chemistry Lab	0	0	2			30	20	50	1
2		Engineering Science Course	Core Courses (CC)- Major	3ESC103P	Programming for Problem SolvingLab	0	0	2			30	20	50	1
3		Engineering ScienceCourse	Skill Enhancement Course (SEC)	3ESC105P	Computer Assembly and Repair Lab	0	0	2			30	20	50	1
											TOTAL		**650**	**20**

NOTE: Mandatory Vocational /Industrial Training(4Weeks) or any specialized course of minimum 4 credits offered by respective department for student opting for exit after first year with UG CERTIFICATE

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SEMESTER III														
S. No		**BROAD CATEGORY**	**CATEGORY**	**CODE**	**COURSE TITLE**	**Periods**			**Evaluation Scheme**				**Subject Total**	**Credit**
						L	**T**	**P**	**Assignment**	**TA**	**Total**	**ESE**		
1	5	Basic Science Course	Core Courses (CC)-Major	3BSC201	Mathematics III (Probability & Statistics)	2	0	0	20	10	30	70	100	2
2		Basic ScienceCourse	Core Course (CC)-Minor	3BSC202	Biological Science for Engineers	3	0	0	20	10	30	70	100	3
3		Engineering Science Course	Core Course (CC)-Minor	3ESC201	Analog Electronics Circuit	3	0	0	20	10	30	70	100	3
4		Professional CoreCourse	Core Courses (CC)-Major	3PCCCS201	Data Structure AndAlgorithms	3	0	0	20	10	30	70	100	3
5		Professional Core Course	Core Courses (CC)-Major	3PCCCS202	Computer Organization &Architecture	3	0	0	20	10	30	70	100	3
6		Humanities and Social Science	Ability Enhancement Course (AEC)	3HSMC201	Effective Technical Communication	2	0	0	20	10	30	70	100	2
8		**Mandatory Course**	**Value Added Course (VAC)**	**3UMC102**	**Community Engagement and Social Responsibility**	**1**	**0**	**2**	**40**	**10**	**50**	**50**	**100**	**2**
PRACTICAL /SESSIONAL														
1	5	Engineering Science Course	Core Course (CC)-Minor	3ESC201P	Analog Electronics Circuit Lab	0	0	2			30	20	50	1
2		Professional core Course	Core Courses (CC)-Major	3PCCCS201P	Data Structure And Algorithms Lab	0	0	2			30	20	50	1
3		Professional core Course	Core Courses (CC)-Major	3PCCCS202P	ComputerOrganization & Architecture Lab	0	0	2			30	20	50	1
											TOTAL		**850**	**21**

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SEMESTER IV														
S.No.		BROAD CATEGORY	CATEGORY	CODE	COURSE TITLE	Periods			Evaluation Scheme				Subject Total	Credit
						L	T	P	Assignment	TA	Total	ESE		
1	5	Engineering ScienceCourse	Core Course (CC)-Minor	3ESC202	Digital Electronics	3	0	0	20	10	30	70	100	3
2		Professional CoreCourse	Core Courses (CC)-Major	3PCCCS203	Object Oriented Programming with JAVA	3	0	0	20	10	30	70	100	3
3		Professional CoreCourse	Core Courses (CC)-Major	3PCCCS204	Discrete Mathematics	3	1	0	20	10	30	70	100	4
4		Professional CoreCourse	Core Courses (CC)-Major	3PCCCS205	Design & Analysis of Algorithms	3	0	0	20	10	30	70	100	3
5		Humanities andSocial Sciences	Skill Enhancement Course (SEC)	3HSMC203	Entrepreneurship	3	0	0	20	10	30	70	100	3
6		Value Added Course	Value Added Course (VAC)	3VAC201	Character Building & Holistic Development of Personality-II (Yoga and Physical Fitness)	2	0	0	20	10	30	70	100	2
PRACTICAL /SESSIONAL														
1	5	Engineering ScienceCourse	Core Course (CC)-Minor	3ESC202P	Digital Electronics Lab	0	0	2			30	20	50	1
2		Professional Core Course	Core Courses (CC)-Major	3PCCCS205P	Design & Analysis of Algorithms Lab	0	0	2			30	20	50	1
3		Professional Core Course	Core Courses (CC)-Major	3PCCCS203P	Object Oriented Programming with JAVA	0	0	2			30	20	50	1
											TOTAL		**850**	**21**

NOTE: Mandatory Vocational /Industrial Training(4Weeks) or any specialized course of minimum 4 credits offered by respective department for student opting for exit after second year with UG DIPLOMA

SEMESTER V													
S. No		BROAD CATEGORY	CATEGORY	CODE	COURSE TITLE	Periods			Evaluation Scheme				Subject Total	Credit
						L	T	P	Assignment	TA	Total	ESE		
1	5.5	Professional Core Course	Core Courses (CC)-Major	3PCCCS301	Database Management Systems	3	0	0	20	10	30	70	100	3
2		Professional Core Course	Core Courses (CC)-Major	3PCCCS302	Formal Language & Automata Theory	3	0	0	20	10	30	70	100	3
3		Professional Core Course	Core Courses (CC)-Major	3PCCCS304	IT Workshop (Sci Lab/MATLAB)	2	0	0	20	10	30	70	100	2
4		Professional Core Course	Core Courses (CC)-Major	3PCCCS305	Operating Systems	3	0	0	20	10	30	70	100	3
5		Track Elective	Core Courses (CC)-Major		Track Elective - 1	3	0	2	20	10	30	70	150	4
6		Value Added Course	Value Added Course (VAC)	3VAC301	Character Building & Holistic Development of Personality-III (Universal Human Values and Ethics)	2	0	0	20	10	30	70	100	2
7		Internship	Internship	3INT301	Internship	0	0	4				100	100	2
PRACTICAL /SESSIONAL														
1	5.5	Professional Core Course	Core Courses (CC)-Major	3PCCCS301P	Database Management Systems Lab	0	0	2			30	20	50	1
2		Professional Core Course	Core Courses (CC)-Major	3PCCCS304P	IT Workshop (Sci Lab/MATLAB)	0	0	2			30	20	50	1
3		Professional CoreCourse	Core Courses (CC)-Major	3PCCCS305P	Operating Systems Lab	0	0	2			30	20	50	1
											TOTAL		**900**	**22**

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SEMESTER VI														
S.No.		BROAD CATEGORY	CATEGORY	CODE	COURSE TITLE	Periods			Evaluation Scheme				SubjectTotal	Credit
						L	T	P	Assignment	TA	Total	ESE		
1	5.5	Professional Core Course	Core Courses (CC)-Major	3PCCCS306	Compiler Design	3	0	0	20	10	30	70	100	3
2		Professional Core Course	Core Courses (CC)-Major	3PCCCS307	Computer Networks	3	0	0	20	10	30	70	100	3
3		Professional Core Course	Core Courses (CC)-Major	3PCCCS308	Fundamentals of Software Engineering	3	0	0	20	10	30	70	100	3
4		Track Elective	Core Courses (CC)-Major		Track Elective II	3	0	0	20	10	30	70	100	3
5		Track Elective	Core Courses (CC)-Major		Track Elective III	3	0	0	20	10	30	70	100	3
6		Open ElectiveCourse	Core Course (CC)-Minor		Open Elective I / MOOCs I	3	0	0	20	10	30	70	100	3
PRACTICAL /SESSIONAL														
1	5.5	Professional CoreCourse	Core Courses (CC)-Major	3PCCCS306P	Compiler DesignLab	0	0	2			30	20	50	1
2		Professional CoreCourse	Core Courses (CC)-Major	3PCCCS307P	Computer Networks Lab	0	0	2			30	20	50	1
3		Professional CoreCourse	Core Courses (CC)-Major	3PCCCS308P	Fundamentals of Software Engineering Lab	0	0	2			30	20	50	1
4		Project	Project	3PROJCS301	Project-I	0	0	6	20	10	50	50	100	3
											TOTAL		800	24

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SEMESTER VII

S. No		BROAD CATEGORY	CATEGORY	CODE	COURSE TITLE	Periods			Evaluation Scheme				SubjectTotal	Credit
						L	T	P	Assignment	TA	Total	ESE		
1	6	Track Elective	Core Courses (CC)- Major		Track Elective IV	3	0	0	20	10	30	70	100	3
2		Track Elective	Core Courses (CC)- Major		Track Elective V	3	0	2	20	10	30	70	150	4
3		Track Elective	Core Courses (CC)- Major		Track Elective VI	3	0	0	20	10	30	70	100	3
4		Professional Core Course	Core Courses (CC)- Major	3PCCCS401	Introduction to Cyber Security	3	0	0	20	10	30	70	100	3
5		Open ElectiveCourse	Multidisciplinary Course (MDC)		Open Elective II / MOOCs II	3	0	0	20	10	30	70	100	3
PRACTICAL /SESSIONAL														
2	6	Project	Project	3PROJCS401	Project-II	0	0	8			100	100	200	4
											TOTAL		**650**	**20**

SEMESTER VIII

S.No.		BROAD CATEGORY	CATEGORY	CODE	COURSE TITLE	Periods			Evaluation Scheme				SubjectTotal	Credit
						L	T	P	Assignment	TA	Total	ESE		
1	6	Track Elective	Core Courses (CC)- Major		Track Elective VII	4	0	0	20	10	30	70	100	4
2		Open ElectiveCourse	Core Course (CC)- Minor		Open Elective-III / MOOCs III	3	0	0	20	10	30	70	100	3
3				3UMC101	Managing Personal Finance ##	2	0	0			50	0	50	0
PRACTICAL /SESSIONAL														
1	6	Project	Project	3PROJCS402	Project-III	0	0	16			100	100	200	8
											TOTAL		**450**	**15**

Semester	Total Credit (Without Vocational Course)	Total Credit (With Vocational Course)
1	20	20
2	20	20
Year 1 (Certificate)	40	44
3	21	21
4	21	21
Year 2 (Diploma)	82	86
5	22	
6	24	
	128	NA
7	20	
8	15	
Year 4 (B. Tech Regular)	163	NA

NOTE: Qualifying Non-Credit Course

NOTE: 20% credit earned through MOOC(SWAYAM) in the course

B. Tech (CSE)

CHOICE BASED CREDIT SYSTEM

	Category	Credit Distribution	Proposed Credit Points	
1	Core Courses (CC)- Major	80	79	
2	Core Course (CC)- Minor	32	31	
3	Multidisciplinary Course (MDC)	9	10	
4	Ability Enhancement Course (AEC)	8	5	
5	Skill Enhancement Course (SEC)	9	10	
6	Value Added Course (VAC)	06-08	11	
7	Project	12	15	
8	Internship	02-04	2	
Total Credits			**163**	

Track Elective						
	CODE	Specialisation in ARTIFICIAL INTELLIGENCE	L	T	P	C
SEM V	3TECCS301	Introduction to Python Programming	3	0	2	4
	3TECCS302	Advanced Software Engineering	3	0	2	4
	3TECCS307	Pattern Recognition	4	0	0	4
	3TECCS308	Intelligent systems	4	0	0	4
SEM VI	3TECCS311	Distributed Database Management System	3	0	2	4
	3TECCS312	Machine Learning	3	0	0	3
	3TECCS313	Web Technology	3	0	2	4
	3TECCS319	Statistics for Artificial Intelligence	3	0	0	3
	3TECCS318	Data Mining	3	0	0	3
	3TECCS320	Knowledge Representation	3	0	0	3
SEM VII	3TECCS401	Internet -of-Things	3	0	0	3
	3TECCS402	Artificial Intelligence	3	0	2	4
	3TECCS410	Supervised Machine Learning	3	0	0	3
	3TECCS411	Deep Learning	3	0	0	3
	3TECCS412	Natural Language Processing	3	0	0	3
	3TECCS406	AI for games	3	0	2	4
SEM VIII	3TECCS421	Computer Vision	4	0	0	4
	3TECCS422	Unsupervised Machine Learning	4	0	0	4
	3TECCS423	Introduction to Robotics	4	0	0	4
	3TECCS424	AI/ML Analyst	4	0	0	4

Open Electives					
Select any one in VI, VII, VIII semester					
Code	**Course Title**	**L**	**T**	**P**	**Credits**
3OEC101	Cryptography and Network Security	3	0	0	3
3OEC102	Cyber Law and Ethics	3	0	0	3
3OEC103	Indian Knowledge System	3	0	0	3

- Open Elective can be opted by MOOCs
- The students of B.Tech CSE can opt for any of the courses offered by the other Departments / Programs in the same semester

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Detailed Assessment Scheme

Assessment Scheme				
CIA- Continuous Internal Assessment (50 Marks)				
Assessment Parameters	**Assessment Tools**	**Marks**	Bloom's Taxonomy Category	Bloom's Taxonomy Level LOT/HOT
Assignment 1	Assignment consisting of minimum 5 Questions	10	Remember, Understand, Apply	LOT
Assignment 2	Assignment consisting of minimum 2 Questions	10	Analyze, Evaluate, Create	HOT
Teacher Assessment/ Class Participation				
Teacher Assessment 1	Quiz, Case Studies, Presentations, Group Discussion, Lab work, Project or any other	10	Remember, Understand, Apply	LOT
Teacher Assessment 2	Quiz, Case Studies, Presentations, Group Discussion, Lab work, Project or any other activity	10	Analyze, Evaluate, Create	HOT
Class Participation	Brainstorming, Discussion, Attendance, Extempore or any other activity	10		

(LOT: Low Order Thinking, HOT: High Order Thinking)

'ESE- End Semester Examination (70 Marks)		
Bloom's Taxonomy Category	**ESE Question Paper Section**	**Bloom's Taxonomy Level LOT/HOT**
Remember	A	LOT
Understand	A	
Apply	B	LOT/ HOT
Analyze	B	
Evaluate & Create	C	HOT

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Semester I

SEMESTER I														
S. No	**NSQF/ NATIONAL CREDIT FRAMEWORK NCrF CREDIT LEVEL**	**BROAD CATEGORY**	**CATEGORY**	**CODE**	**COURSE TITLE**	**Periods**			**Evaluation Scheme**				**Subject Total**	**Credit**
						L	**T**	**P**	**Assignment**	**TA**	**Total**	**ESE**		
1	4.5	Basic ScienceCourse	Multidisciplinary Course (MDC)	3BSC101	Physics	3	1	0	20	10	30	70	100	4
2		Basic ScienceCourse	Core Course (CC)-Minor	3BSC102	Mathematics I	3	1	0	20	10	30	70	100	4
3		Engineering ScienceCourse	Core Course (CC)-Minor	3ESC101	Basic Electrical Engineering	3	1	0	20	10	30	70	100	4
4		Engineering Science Course	Core Course (CC)-Minor	3ESC102	Engineering Graphics & Design	2	0	0	20	10	30	70	100	2
5		Humanities andSocial Sciences	Ability Enhancement Courses (AEC)	3HSMC101	English	3	0	0	20	10	30	70	100	3
PRACTICAL /SESSIONAL														
1	4.5	Basic Science Course	Skill Enhancement Course (SEC)	3BSC101P	Physics Lab	0	0	2			30	20	50	1
2		Engineering Science Course	Skill Enhancement Course (SEC)	3ESC101P	Basic Electrical Engineering Lab	0	0	2			30	20	50	1
3		Engineering Science Course	Skill Enhancement Course (SEC)	3ESC102P	Engineering Graphics & Design Lab	0	0	2			30	20	50	1
											TOTAL		**650**	**20**

Program: B.Tech

Semester: First

Course: Physics

Course Code: 3BSC101

L	T	P	C
3	1	0	4

Course Objective:

The objective of this course is

- To equip the students with standard concepts of Physics and applications of Physics.
- To understand the concept of various types of Electromagnetic Theory.
- Detail study of Quantum Mechanics.
- To understand Laws and different Phenomena of Wave Optics.
- Detail study of Laser, types of Laser and applications of Laser.
- To understand the concept of Semiconductor Physics and Semiconductor devices.

Course Outcome:

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

CO1: Know the basic concepts of electromagnetic theory and their application.

CO2: Know about the dual nature of matter and wave equation.

CO3: Demonstrate the types of motion and different types of forces.

CO4: Design the concept of wave optics, types of lasers, classification of laser and their application.

CO5: Know about the different types of diodes and their characteristics.

Course Content:

Topics	Hours
Unit I	
Laplace's and Poisson's equations for electrostatic potential and. Boundary conditions of electric field and electrostatic Potential. Energy of a charge distribution and its expression in terms of electric field. Solving simple electrostatics problems in presence of dielectrics – Point charge at the centre of a dielectric sphere, Bio-Savart law, Divergence and curl of static magnetic field; Magnetization magnetic susceptibility and ferromagnetic, paramagnetic and diamagnetic materials. Faraday's law in terms of EMF produced by changing magnetic flux, Lenz's law. Differential form of Faraday's law Displacement current and Maxwell's equations, **Learn about traditional Indian methods of measurement, early knowledge of metals and materials, sky observation in Indian astronomy, and ancient timekeeping tools like sundials and water clocks.**	10
Unit II	
Introduction to Quantum mechanics, Wave nature of Particles, Time-dependent and time independent Schrodinger equation for wave function, Uncertainty principle. Solution of stationary-state Schrodinger equation for one dimensional problems– particle in a box, particle in three dimensional box.	7
Unit III	
Scalars and vectors Forces in Nature; Newton's laws and its completeness in describing particle motion; Form invariance of Newton's Second Law; Solving Newton's equations of motion in polar coordinates; F = - Grad V; Definition and motion of a rigid body in the plane; Rotation in he plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion; Euler's laws of motion, their independence from Newton's laws, and their necessity in describing rigid body motion; Examples.	8
Unit IV	
Mechanical and electrical simple harmonic oscillators. Brewster's Law, total internal reflection, Mirrors & lenses and optical instruments based on them. Amplification of light by population inversion, different types of lasers: gas lasers (He-Ne), solid-state lasers (ruby Laser).Properties of laser beams, applications of lasers in science, engineering and medicine.	8
Unit V	
P-N junction, Metal-semiconductor junction (Ohmic and Schottky); Carrier transport, generation, and recombination; Semiconductor materials of interest for optoelectronic devices. Rates of optical transitions LED: device structure, materials, characteristics, and figures of merit. Types of semiconductor photodetectors -p-n junction, PIN, and Avalanche.	7

Suggested Reading:

1. Engineering Physics: R.K.Gaur & S.L. Gupta
2. Engineering Physics: G.S. Raghuvanshi
3. Modern Engineering Physics: A.S.Vasudeva
4. David Griffiths, Introduction to Electrodynamics
5. Halliday and Resnick, Physics
6. D. J. Griffiths, Quantum
7. Engineering Mechanics, 2nd ed. — MK Harbola
8. D. J. Griffiths, "Quantum mechanics", Pearson Education.
9. S. M. Sze, Semiconductor Devices: Physics and Technology.

Program: B.Tech

Semester: First

Course: Physics Lab

Course Code: 3BSC101P

L	T	P	C
0	0	2	1

List of Laboratory Experiments/Demonstrations:

1. Find the acceleration due to gravity using Kater's pendulum.
2. Find the resistance of a given wire using Meter Bridge.
3. To establish the current voltage relationship for a metallic conductor and find its resistance.
4. To determine the unknown resistance of given wire using Potentiometer.
5. Find the acceleration due to gravity using Simple pendulum.
6. To determine Young' modulus of the material of a given wire using Searle's Apparatus
7. To determine the unknown resistance of given wire using Potentiometer.
8. To determine the wavelength of sodium light by Newton's ring method.
9. To measure the wavelength of Mercury spectrum using Spectrometer grating.
10. To study the variation of magnetic field with distances using Helmholtz Galvanometer.

Program: B.Tech

Semester: First

Course: Mathematics I

Course Code: 3BSC102

L	T	P	C
3	1	0	4

Course Objective:

The objective of this course is

- To develop an understanding of matrix theory and its applications in solving linear systems and transformations.
- To equip students with the concepts of single-variable calculus including theorems, series expansion, and evaluation of integrals.
- To introduce multivariable calculus for functions of several variables and optimization techniques.
- To provide knowledge on multiple integrals and their applications in geometry and physics.
- To familiarize students with infinite sequences, series, and Fourier series representations of functions.

Course Outcome:

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

CO 1: Apply matrix operations, eigenvalues, eigenvectors, diagonalization, and the Cayley-Hamilton Theorem to solve linear algebra problems and systems of equations.

CO 2: Use theorems of calculus such as Rolle's and Mean Value Theorems, Taylor/Maclaurin expansions, and evaluate definite and improper integrals using special functions like Beta and Gamma.

CO 3: Compute partial derivatives, directional derivatives, and use the method of Lagrange multipliers for optimization in multivariable functions.

CO 4: Evaluate double and triple integrals using Cartesian and polar coordinates and apply them to calculate areas and volumes in different coordinate systems.

CO 5: Analyze the convergence of sequences and series, apply various tests, and represent functions

Course Content:

Topics	Hours
Unit I	10
Matrices: System of linear equations; rank of a matrix, rank-nullity theorem; Symmetric, skew symmetric and orthogonal matrices; Eigen values and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation; Cramer's rule, **Explore ancient Indian number systems, early use of trigonometry in astronomy, and algebraic techniques developed by Indian mathematicians.**	
Unit II	7
Calculus: Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and Hospital's rule, Evaluation of definite and improper integrals; Beta and Gamma functions and their properties.	
Unit III	8
Multivariable Calculus (Differentiation): Partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points, Method of Lagrange multipliers.	
Unit IV	8
Multivariable Calculus (Integration): Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, change of variables (Cartesian to polar), Applications: areas and volumes, Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes and sphere.	
Unit V	7
Sequences and series: Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and Logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.	

Suggested Reading:

1. H.K. Dass, "Advance Engineering Mathematics''; S.Chand &Co., 9th Revised Ed., 2001.
2. B.S. Grewal, "Higher Engineering Mathematics''.
3. E. Kreyszig, "Advance Engineering

Program: B.Tech

Semester: First

Course: Basic Electrical Engineering

Course Code: 3ESC101

L	T	P	C
3	1	0	4

Course Objective:

The objective of this course is

- To study the electrical circuit network with DC Excitation.
- To understand phasor diagram of different electrical circuit for AC Excitation.
- To understand different types of transformer with single phase & three phase connection.
- To study the construction & working principles of different types Electrical Machine.
- To understand the power converters with switch gear protection for electrical equipment's, Earthing & types of battery.

Course Outcome:

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

CO1: Demonstrate and apply basics of electrical circuit theorms on D.C Supply & A.C waveform with the Phasor diagram & power measurement.

CO2: Apply fundamentals of electromagnetism and basic concept of single-phase & three phase transformer with their regulation, efficiency and estimation of losses.

CO3: Realize the concept and working of different types of DC and AC machines and will be able to select right machine to meet desired needs for implementing engineering solutions.

CO4: Understand the basic circuits converters, inverters, Switchgear protection, earthing & types of battery.

Course Content:

Topics	Hours
Unit I	8
D.C. Circuits Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits, Understand how ancient Indian texts described energy and electricity, including natural phenomena like lightning and static electricity.	
Unit II	8
A.C. Circuits Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections.	
Unit III	6
Transformers Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.	
Unit IV	8
Electrical Machines Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.	
Unit V	6
Power Converters DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.	
Unit VI	6
Electrical Installations Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.	

Suggested Reading:

1. Basic Electrical Engineering - D.P. Kothari and I.J. Nagrath, 3rd edition 2010, Tata McGraw Hill.
2. Basic Electrical Engineering - D.C. Kulshreshtha, 2009, Tata McGraw Hill.
3. Fundamentals of Electrical Engineering, L.S. Bobrow, Oxford University Press, 2011
4. Electrical and Electronics Technology, E. Hughes, 10th Edition, Pearson, 2010
5. Electrical Engineering Fundamentals, Vincent Deltoro, Second Edition, Prentice Hall India, 1989

Program: B.Tech

Semester: First

Course: Basic Electrical Engineering Lab

Course Code: 3ESC101P

L	T	P	C
0	0	2	1

List of Laboratory Experiments/Demonstrations:

1. Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidalsteady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
3. Transformers: Observation of the no-load current waveform on an oscilloscope (non- sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
4. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts betweenthe primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
5. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
6. Torque Speed Characteristic of separately excited dc motor.
7. Synchronous speed of two and four-pole, three-phase induction motors. Direction reversalby change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super-synchronous speed.
8. Synchronous Machine operating as a generator: stand-alone operation with a load. Controlof voltage through field excitation.
9. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the useof dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

Program: B.Tech

Semester: First

Course: Engineering Graphics & Design

Course Code: 3ESC102

L	T	P	C
2	0	0	2

Course Objective:

The objective of this course is

- To introduction to engineering design and its place in society
- To exposure to the visual aspects of engineering design
- To exposure to engineering graphics standards
- To exposure to solid modeling
- To exposure to computer-aided geometric design
- To exposure to creating working drawings
- To exposure to engineering communication

Course Outcome:

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

CO1: Know and understand the conventions and the method of engineering drawing.

CO2: Interpret engineering drawings using fundamental technical mathematics.

CO3: Construct basic and intermediate geometry.

CO4: To improve their visualization skills so that they can apply this skill in developing new products.

CO5: To improve their technical communication skill in the form of communicative drawings.

CO6: Comprehend the theory of projection.

Course Content:

Traditional Engineering Graphics: Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics: Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM)

Topics	Hours
Unit I	7
Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain, Diagonal and Vernier Scales, Study symmetry in traditional Indian art (Mandala), design principles from Vastu Shastra, and ancient systems of measurement from Shilpa Shastra.	
Unit II	4
Orthographic Projections covering, Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes.	
Unit III	4
Projections of Regular Solids covering, those inclined to both the Planes-Auxiliary Views; Draw simple annotation, dimensioning and scale.	
Unit IV	4
Sections and Sectional Views of Right Angular Solids covering, Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone.	
Unit V	4
Isometric Projections covering, Principles of Isometric projection – Isometric Scale, Isometric Views; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions	
Unit VI	4
Overview of Computer Graphics covering, demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System, The Status Bar.	
Unit VII	4
Customization & CAD Drawing consisting of set up of the drawing page and the printer, including scale settings, setting up of units and drawing limits.	
Unit VIII	5
Annotations, layering & other functions covering applying dimensions to objects, Changing line lengths through modifying existing lines (extend/lengthen); Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling.	
	4

Unit IX
Creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; Introduction to Building Information Modelling (BIM).

Suggested Reading:

1. Engineering Drawing textbook Intro By : N D Bhatt
2. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, CharotarPublishing House
3. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, PearsonEducation
4. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
5. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, ScitechPublishers
6. (Corresponding set of) CAD Software Theory and User Manuals By: R K Dhavan
7. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, CharotarPublishing House
8. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, PearsonEducation
9. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
10. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, ScitechPublishers
11. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics,Pearson Education
12. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication

Program: B.Tech

Semester: First

Course: Engineering Graphics & Design Lab

Course Code: 3ESC102P

L	T	P	C
0	0	2	1

Laboratory Experiments/Demonstrations is to be conducted as per module content.

Program: B.Tech
Semester: First
Course: English
Course Code: 3HSMC101

L	T	P	C
3	0	0	3

Course Objective:

The objectives of the course are:

- To enhance Professional competence in reading, writing, listening and speaking.
- Switch the approach from providing information about the language to use the language.
- To use English effectively for study purpose across the curriculum and to revise and reinforce structure already learnt.
- Introduce Communicative Method of ELT and focusing the teaching pedagogy on the student-centered learning rather than on the teacher-centered learning.
- Ability to master three major forms of communications which are vital in academic and professional settings namely professional presentations, interviews and group communications respectively.
- Providing a deep insight into the techniques for delivering effective presentations, winning job interviews, and actively participating in various forms of group communication.

Course Outcome:

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

CO1: Design language components or processes that meet specific needs within realistic constraints.
CO2: Analyze the contextual usage of English words.
CO3: Develop strong comprehension of technical and academic articles.
CO4: Confidently present themselves in multinational settings, adapting to different English standards.
CO5: Evaluate and produce correct, error-free writing, applying appropriate communication and presentation styles for both professional and academic contexts.
CO6: Apply practical presentation skills and voice dynamics in oral presentations.

Course Content:

Topics	Hours
Unit I	3
Vocabulary Building : The concept of Word Formation, Root words from foreign languages and their use in English, Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives, Synonyms, antonyms, and standard abbreviations, Learn about communication methods in ancient India, contributions to world literature by Indian thinkers, and how Sanskrit influenced language structure and grammar.	
Unit II	4
Basic Writing Skills: Sentence Structures, Use of phrases and clauses in sentences, Importance of proper punctuation, Creating coherence, Organizing principles of paragraphs in documents, Techniques for writing precisely	
Unit III	3
Identifying Common Errors in Writing: Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies, Clichés	
Unit IV	4
Nature and Style of sensible Writing: Describing, Defining, Classifying, Providing examples or evidence, writing introduction and conclusion	
Unit V	4
Writing Practices: Comprehension, Précis Writing, Essay Writing	
Unit VI	6
Oral Communication: (This unit involves interactive practice sessions in Language Lab) - Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common Everyday Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations	

Suggested Readings:

1. Practical English Usage. Michael Swan. OUP. 1995.
2. Remedial English Grammar. F.T. Wood. Macmillan.2007
3. On Writing Well. William Zinsser. Harper Resource Book. 2001
4. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
5. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
6. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

JHARKHAND Rai University
RANCHI

Semester II

SEMESTER II														
S.No.		**BROAD CATEGORY**	**CATEGORY**	**CODE**	**COURSE TITLE**	**Periods**			**Evaluation Scheme**				**Subject Total**	**Credit**
						L	**T**	**P**	**Assignment**	**TA**	**Total**	**ESE**		
1	4.5	Basic ScienceCourse	Multidisciplinary Course (MDC)	3BSC103	Chemistry	3	1	0	20	10	30	70	100	4
2		Basic ScienceCourse	Core Course (CC)- Minor	3BSC104	Mathematics II	3	1	0	20	10	30	70	100	4
3		Engineering ScienceCourse	Core Courses (CC)- Major	3ESC103	Programming for Problem Solving	3	0	0	20	10	30	70	100	3
4		Engineering ScienceCourse	Skill Enhancement Course (SEC)	3ESC105	Computer Assembly and Repair	1	0	0	20	10	30	70	100	1
5		Mandatory Course	Value Added Course (VAC)	3MC101	Environmental Science	3	0	0	20	10	30	70	100	3
6		Value Added Course	Value Added Course (VAC)	3VAC101	Character Building & Holistic Development of Personality -I (Spiritual & Mental Health)	2	0	0	20	10	30	70	100	2
PRACTICAL /SESSIONAL														
1	4.5	Basic ScienceCourse	Skill Enhancement Course (SEC)	3BSC103P	Chemistry Lab	0	0	2			30	20	50	1
2		Engineering Science Course	Core Courses (CC)- Major	3ESC103P	Programming for Problem SolvingLab	0	0	2			30	20	50	1
3		Engineering ScienceCourse	Skill Enhancement Course (SEC)	3ESC105P	Computer Assembly and Repair Lab	0	0	2			30	20	50	1
											TOTAL		**650**	**20**

NOTE: Mandatory Vocational /Industrial Training(4Weeks) or any specialized course of minimum 4 credits offered by respective department for student opting for exit after first year with UG CERTIFICATE

Program: B.Tech

Semester: Second

Course: Chemistry

Course Code: 3BSC103

L	T	P	C
3	1	0	4

Course Objective:

The objectives of the course are:

- To bring adaptability to new developments in Engineering Chemistry and to acquire the skills required to become a perfect engineer.

- The knowledge gained on spectroscopy; stereochemistry will provide a strong platform to understand the concepts on these subjects for further learning.
- To acquire knowledge of the basic 3D structure in organic chemistry including stereochemistry, aromaticity and reaction mechanism.
- To develop knowledge on the physical state and electrochemistry of molecules and significance of corrosion.

Course Outcome:

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

CO 1: Learn about the bonding in a molecular structure of simple and complex molecule, magnetism and isomerism in complex molecule.

CO 2: Learn about limitations of classical mechanics and solution in terms of quantum mechanics for atomic/molecular systems. Gain insight into the basic principles of UV, IR and NMR spectroscopic techniques. Use spectroscopic techniques to determine structure and stereochemistry of known and unknown compounds.

CO 3: Learn about aromaticity of organic compound identify and differentiate prochirality and chirality at centres, axis and determine the absolute configuration. Evaluate the stability of various conformers of acyclic and cyclic systems

CO 4: Learn about the rate of reaction, order and molecularity of reaction, mechanism of a simple as well as catalytic reaction.

CO 5: Learn about the phases and the electrochemical behavior of the molecules, EMF of cell and its application.

Course Content:

Topics	Hours
Unit I	8
Chemical Bonding: Ionic bond: Radius ratio rule, Metallic Bond: valence bond and band theories, defects in solids, Werner's Theory, Bonding in Transition metal complexes, Ligands, coordination complexes, Crystal Field Theory, Octahedral and Tetrahedral complexes, CFSE, Jahn Teller theorem, magnetism, and isomerization in coordination compounds, Traditional Indian chemical knowledge in natural dyes, pottery, cement, glass-making, and metal tools.	
Ionic bond: Radius ratio rule, Metallic Bond: valence bond and band theories, defects in solids, Werner's Theory, Bonding in Transition metal complexes, Ligands, coordination complexes, Crystal Field Theory, Octahedral and Tetrahedral complexes, CFSE, Jahn Teller theorem, magnetism, and isomerization in coordination compounds.	
Unit II	7
Spectroscopic techniques and applications :	
Principles of spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging.	
Unit III	4
Organic Structure and Stereochemistry:	
Covalent bond: Lewis structure, Valence Bond theory, Molecular orbital theory, Molecular orbital of diatomic and polyatomic system, hybridization, conjugated molecules, Huckel molecular orbital theory of conjugated systems. Isomerism, Geometrical isomerism: cis–trans and syn-anti isomerism; Optical isomerism & Chirality; Wedge, Fischer, Newmann and Sawhorse Projection formulae and interconversions; Conformational studies of ethane, n-butane, Cyclohexane	
Unit IV	6
Kinetics and Catalysis:	
Order & molecularity of reactions, kinetics of zero, first & second order reaction Characteristics of catalyst, types of catalysis, theories of catalysis; Acid base catalysis, Enzyme catalysis, Important catalysts in industrial processes; Hydrogenation using Wilkinson's catalyst,	
Unit V	6
Phase and Chemical equilibrium:	
Phase Rule: Terms Involved, Phase diagram of one component (Water) their applications. Law of chemical equilibrium, equilibrium constants and their significance, Weak and strong electrolytes, Standard electrode potential and its application, EMF and its measurement and application, the Nernst equation, Chemical and Electrochemical corrosion, Factors affecting the rate of corrosion.	

Suggested Reading:

1. University chemistry, by B. H. Mahan
2. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
3. Fundamentals of Molecular Spectroscopy, by C. N. Banwell

4. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
5. Physical Chemistry, by P. W. Atkins
6. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore.
7. Engineering Chemistry by Jain & Jain.
8. Engineering Chemistry by O P Agarwal.

Program: B.Tech

Semester: Second

Course: Chemistry Lab

Course Code: 3BSC103P

L	T	P	C
0	0	2	1

List of Laboratory Experiments/Demonstrations:

List of Laboratory Experiments/Demonstrations:

1. Know your lab

Volumetric Analysis:

2. Determine the Strength of NaOH Solution (Standard Hydrochloric acid Solution Supplied).
3. Determination of chloride content of water sample by argentometric method
4. Determination of DO content of water sample by Winkler's methods.
5. Determination of acidity of water sample
6. To draw pH-titration curve of strong acid vs strong base

pH meter:

7. Determination of pH of a given sample using pH meter:

Preparations:

8. Preparation of N/10 solution
9. Synthesis of Aspirin

Additional experiments

10. Determination of surface tension and Viscosity
11. Determination of the rate constant of a reaction
12. Adsorption of acetic acid by charcoal
13. Saponification/acid value of an oil

Program: B.Tech

Semester: Second

Course: Mathematics II

Course Code: 3BSC104

L	T	P	C
3	1	0	4

Course Objective:

The objectives of the course are:

- To solve first-order differential equations using standard methods.
- To analyze and solve higher-order linear differential equations.
- To apply power series solutions to differential equations and study special functions.
- To formulate and solve partial differential equations with boundary and initial conditions.
- To apply vector calculus operations and theorems in solving engineering problems.

Course Outcome:

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

CO1: Solve various types of first-order differential equations and understand their applications in modeling physical systems.

CO2: Apply methods like variation of parameters and Cauchy-Euler technique to solve second-order and higher-order differential equations.

CO3: Use power series methods to find solutions to differential equations and explain the properties of Legendre and Bessel functions.

CO4: Classify and solve partial differential equations of first and second order using standard methods like separation of variables and D'Alembert's solution.

CO5: Evaluate scalar and vector line and surface integrals, and apply Green's, Gauss's, and Stokes's theorems to solve problems in vector calculus.

Course Content:

Topics	Hours
Unit I	10
First order ordinary differential equations: Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type, Introduction to Vedic Math, early calculus ideas, matrix concepts, and algebra by Aryabhata and Brahmagupta.	
Unit II	10
Ordinary differential equations of higher orders: Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation.	
Unit III	10
Power series : Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.	
Unit IV	10
Partial Differential Equations : Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification, Initial and boundary conditions, D'Alembert's solution of the wave equation; Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates.	
Unit V	5
Vector calculus : Gradient, curl and divergence ; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.	

Suggested Readings:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
4. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
5. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
6. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
7. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc- Graw Hill, 2004.
8. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
9. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Program: B.Tech

Semester: Second

Course: Programming for Problem Solving

Course Code: 3ESC103

L	T	P	C
3	0	0	3

Course Objective:

The objectives of the course are:

- To introduce students to the fundamentals of programming concepts**,** including flowcharts, pseudocode, variables, data types, and compilation processes.
- To **d**evelop problem-solving skills using control structures, loops, arrays, and basic algorithmic thinking.
- To enable students to write modular and recursive programs using functions and to understand the significance of recursion and its applications.
- To provide an understanding of advanced programming constructs such as structures, pointers, and file handling for real-world data processing.

Course Outcome:

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

CO1: Construct basic programs using variables, data types, and arithmetic expressions with appropriate control and loop constructs.

CO2: Implement and manipulate arrays and strings effectively for data storage and processing.

CO3: Apply standard algorithms (searching, sorting, root finding) and evaluate basic time complexity.

CO4: Design and implement programs using functions, recursion, pointers, structures, and file handling techniques.

Course Content:

Topics	Hours
Unit I	**2**
Introduction to Programming :	
Introduction to Programming (Flow chart/pseudocode, compilation etc.), Variables (including data types), Ancient Indian computing ideas: binary numbers, Kolam patterns as algorithms, and Panini's grammar as programming logic.	
Unit II	**2**
Arithmetic expressions and precedence	
Unit III	**8**
Conditional Branching and Loops Writing and evaluation of conditionals and consequent branching, Iteration and loops	
Unit IV	**6**
Arrays : Arrays (1-D, 2-D), Character arrays and Strings	
Unit V	**6**
Basic Algorithms : Searching, Basic Sorting Algorithms, Finding roots of equations, idea of time complexity	
Unit VI	**8**
Function and Recursion : Functions (including using built in libraries), Recursion with example programs such as Quick sort, Ackerman function etc.	
Unit VII	**6**
Structure and Pointers : Pointers, Structures (including self-referential structures e.g., linked list, notional introduction)	
Unit VIII	**2**
File handling	

Suggested Reading:

1. E. Balagurusamy – Programming in ANSI C, 3rd Edn. , TMH, New Delhi, 2004
2. Programming with C, B.S.Gottfried (TMH)
3. Y. Kanetkar – Let us C, 4th Edition, BPB Publication, New Delhi; 2002
4. The C Programming Language, B.W. Kernighan, Dennis M.Ritchie, PHI/Pearson Education
5. C Programming with problem solving, J.A. Jones & K. Harrow, Dreamtech Press
6. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice

Program: B.Tech CSE

Semester: Second

Course: Programming for Problem Solving Lab

Course Code: 3ESC103P

L	T	P	C
0	0	2	1

Tutorial and Lab:

Tutorial 1: Problem solving using computers: Lab1: Familiarization with programming environment

Tutorial 2: Variable types and type conversions: Lab 2: Simple computational problems using arithmetic expressions

Tutorial 3: Branching and logical expressions: Lab 3: Problems involving if-then-else structures

Tutorial 4: Loops, while and for loops: Lab 4: Iterative problems e.g., sum of series

Tutorial 5: 1D Arrays: searching, sorting: Lab 5: 1D Array manipulation

Tutorial 6: 2D arrays and Strings, memory structure: Lab 6: Matrix problems, String operations

Tutorial 7: Functions, call by value: Lab 7: Simple functions

Tutorial 8 &9: Numerical methods (Root finding, numerical differentiation, numerical integration): Lab 8 and 9: Numerical methods problems

Tutorial 10: Recursion, structure of recursive calls: Lab 10: Recursive functions

Tutorial 11: Pointers, structures and dynamic memory allocation Lab 11: Pointers and structures

Tutorial 12: File handling: Lab 12: File operations

Program: B.Tech CSE

Semester: Second

Course: Computer Assembly and Repair

Course Code: 3ESC105

L	T	P	C
1	0	0	1

Course Objectives:

The objectives of the course are:

- To introduce and familiarize students with internal and external computer hardware components.
- To develop the ability to perform system assembly/disassembly and basic hardware troubleshooting.
- To enable learners to recover data and connect peripheral devices effectively.
- To impart knowledge on operating system and application software installation and configuration.

Course Outcomes:

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

CO1: Identify, describe, and demonstrate key computer hardware components and ports with their functions.

CO2: Assemble and disassemble a desktop system and troubleshoot common hardware issues such as RAM faults, SMPS failures, and BIOS settings.

CO3: Perform data recovery from USB drives and hard disks, and configure peripheral devices like projectors and audio systems.

CO4: Install and configure different operating systems and application software, including antivirus programs, and observe their performance impacts.

Course Content:

Topics	Hours
Unit I	**5**
Introduction to Computer Hardware Components : • Demonstration of Hardware peripherals: CPU, RAM, SMPS, Motherboard, NIC card, Processor, Processor cooling fan, PCI card, HDD • Demonstration of various ports: CPU, VGA port, PS/2 (keyboard, mouse), USB, LAN, Speaker, Audio • Identify the Computer Name and Hardware Specification (RAM capacity, Processor type, HDD, 32 bit/ 64 bit) • Assemble and Disassemble Desktop System	
Unit II	**5**
Troubleshooting and BIOS Configuration : • Configure BIOS settings – disable and enable USB and LAN • Identify and Troubleshoot the problems of RAM (beep sound with blue screen), SMPS and motherboard (CPU is not switched ON) • Adding additional RAM to the system (expanding RAM size) • Graphic Card insertion	
Unit III	**5**
Data Recovery and Device Connectivity : • Identify how to recover hidden files from corrupted pen drive using command • Recover contents from crashed Hard Disk using Disk Drill software • Add new Hardware device (keyboard, mouse, Speaker, Microphone) • Connect the LCD Projector with Laptop / CPU	
Unit 4:	**5**
Operating System and Software Installation : • Install Operating System – Windows family (Windows 7 / Windows 10) and make partitions • Install Operating System – Unix family (Linux / UBUNTU) • Install Application software – Python 3.8, MS Office 2010/2013, MySQL, TOAD, OpenOffice, etc. • Install any one antivirus software (Avast, Kaspersky, etc.) and observe the variations before and after installation	

References:

1. Dan Gookin, Troubleshooting & Maintaining Your PC ALL-IN-ONE, 3rd Edition,2017, John Wiley & Sons.
2. Mike Meyers, Scott Jernigan, Dan Lachance, ”CompTIA Fundamentals + Exam Guide (All-in-One), 2nd Edition, 2019, Mc Graw Hill Education.

Web References:

1. https://www.youtube.com/watch?v=ItxwyMR0SnY&list=PLeH4ngtDM7eE-1_mdWuXWyZrI_FMHnyJ0&index=5
2. https://www.cleverfiles.com/howto/crashed-hard-drive-recovery.html

Program: B.Tech CSE

Semester: Second

Course: Computer Assembly and Repair Lab

Course Code: 3ESC105P

L	T	P	C
0	0	2	1

Lab Experiments:

1. Demonstration of Hardware peripherals: CPU, RAM, SMPS, Motherboard, NIC card, Processor, Processor cooling fan, PCI card, HDD.
2. Demonstration of various ports: CPU , VGA port, PS/2 (keyboard, mouse) ,USB, LAN, Speaker, Audio.
3. Identify the Computer Name and Hardware Specification (RAM capacity, Processor type, HDD, 32 bit/ 64 bit)
4. Identify and troubleshoot the problems of RAM (beep sound with blue screen), SMPS and motherboard (CPU is not switched ON)
5. Configure BIOS settings- disable and enable USB and LAN.
6. Identify, how to recover the hidden files from corrupted pen drive using command.
7. Recover the contents from crashed Hard Disk using Disk Drill software.
8. Install Operating System – Windows family (Windows 7/ Windows 10) and also make partitions.
9. Install Operating System - Unix family (Linux/UBUNTU)
10. Install Application software – python 3.8, MS- Office 2010/2013, MySQL, TOAD, Open office, etc.,
11. Install any one of the antivirus software (Avast, Kaspersky, etc.,) and observe the variations before and after installation.
12. Add new Hardware device (keyboard, mouse, Speaker, Microphone)
13. Connect the LCD Projector with Laptop / CPU.
14. Adding additional RAM to the system.(expanding RAM size).
15. Graphic Card insertion.
16. Assemble and Disassemble Desktop System.

Program: B.Tech

Semester: Second

Course: Environmental Science

Course Code: 3MC101

L	T	P	C
3	0	0	3

Course Objective:

The objectives of the course are:

- To understand key concepts from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions.
- To appreciate concepts and methods from ecological and physical sciences and their application in environmental problem solving.
- To reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.
- To develop a strong understanding of core concepts and methods from ecological and physical sciences, and apply them effectively to solve environmental problems."
- To appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
- To apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.

Course Outcome:

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

CO1: Understand the environmental impacts of engineering solutions in the context of society and sustainability.

CO2: Analyze environmental issues caused by various developmental activities and propose appropriate mitigation strategies.

CO3: Identify natural resources and apply suitable conservation methods for sustainable development.

CO4: Recognize the importance of ecosystems and biodiversity in maintaining ecological balance.

CO5: Identify major environmental pollutants and suggest suitable pollution control and abatement techniques.

Course Content:

Topics	Hours
Unit I	**8**
Multidisciplinary nature of environmental studies, Natural Resources: Definition, scope and importance need for public awareness. Renewable and non-renewable resources:-Natural resources and associated problems :- a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, Case studies. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. • Role of an individual in conservation of natural resources. • Equitable use of resources for sustainable lifestyles, **Traditional environmental methods: rainwater harvesting, Panchamahabhuta, and herbal farming practices.**	
Unit II	**8**
Ecosystems, Biodiversity and its conservation :• Concept of an ecosystem.• Structure and function of an ecosystem.• Producers, consumers and decomposers.• Energy flow in the ecosystem.• Ecological succession.• Food chains, food webs and ecological pyramids.• Introduction, types, characteristic features, **structure and function of the following ecosystem:** -(a. Forest ecosystem. Grassland ecosystem. Desert ecosystem, d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries),• Introduction – Definition: genetic, species and ecosystem diversity.• Bio geographical classification of India,• **Value of biodiversity:** consumptive use, productive use, social, ethical, aesthetic and option values ,• Biodiversity at global, National and local levels.• India as a mega-diversity nation• Hot-sports of biodiversity.• **Threats to biodiversity:** habitat loss, poaching of wildlife, man-wildlife conflicts.• Endangered and endemic species of India, • Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.	
Unit III:	**7**
Environmental Pollution: Social Issues and the Environment Definition, Cause, effects and control measures of: -(a. Air pollution, b. Water pollution, b. Soil pollution, c. Marine pollution, d.Noise pollution, e. Thermal pollution, f. Nuclear hazards)• **Solid waste Management:** Causes, effects and control measures of urban and industrial wastes. • Role of an individual in prevention of pollution.• Pollution case studies.• **Disaster management:** floods, earthquake, cyclone and landslides.• From Unsustainable to Sustainable development.• Urban problems related to energy.• Water conservation, rain water harvesting, watershed management.• Resettlement and rehabilitation of people; its problems and concerns. Case Studies.• **Environmental ethics:** Issues and possible solutions. • Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust Case Studies.• Wasteland reclamation.• Consumerism and waste products. • Environment Protection Act.• Air (Prevention and Control of Pollution) Act. • Water (Prevention and control of Pollution) Act.• Wildlife Protection Act.• Forest Conservation Act.• Issues involved in enforcement of environmental legislation.• Public awareness.	

Unit IV	
Human Population and the Environment, Field work : • Population growth, variation among nations.• Population explosion – Family Welfare Programme.• Environment and human health.• Human Rights.• Value Education.• HIV/AIDS.• Women and Child Welfare.• Role of Information Technology in Environment and human health.• Case Studies.• Visit to a local area to document environmental assets-river/forest/grassland/hill/mountain.• Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.• Study of common plants, insects, birds.• Study of simple ecosystems-pond, river, hill slopes, etc.	**7**

Suggested Reading:

1. G. Kiely, Environmental Engineering, Irwin/ McGraw Hill International Edition, 1997
2. M. L. Davisand S. J. Masen, Principles of Environmental Engineering and Science, McGraw Hill International Edition 2004
3. D. D. Mishra, Fundamental Concepts in Environmental Studies, S. Chand and company PVT. LTD., 2014

Program: B. Tech

Semester: Second

Course: Character Building & Holistic Development of Personality-I (Spiritual & Mental Health)

Course Code: 3VAC101

L	T	P	C
2	0	0	2

Course Objective:

The objectives of the course are:

- To prepare the student to develop Manomaya Kosha (Development of mind).
- To enable the students to develop Vijnanamaya Kosha (Intellectual Development).
- To develop an understanding of Anandamaya Kosha (Spiritual Development).
- To help the students in understanding the virtue of Vasudhaiva-Kutumbakam (the whole world is one family) and also to transform students into ideal personalities by inculcating sanskaaras.

Course Outcome:

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

CO1: Students will **develop a strong understanding of Manomaya Kosha**.
CO2: Students will be able to **apply the concept of constructive roles**.
CO3: Students will be able to **analyze the principles of spiritual development**.
CO4: Students will be able to **correlate the importance of global unity** ("world as a family") and **develop their Manomaya Kosha, Vijnanamaya Kosha, and Anandmaya Kosha.**

Course Content:

Topics	Hours
Unit I	4
Cognitive Intellectual Development (Manomaya Kosha): Character Building: - Meaning, Concept, Constituent elements of character and means/ways of character building. **Manomaya Kosha:** General Introduction, Meaning and Concept. **Manomaya Kosha:** Objectives, Characteristics and Significance**. Benefits of developed Manomaya Kosha and deficiencies due to underdeveloped Manomaya Kosha. Means, Activities and Programmes to develop Manomaya Kosha.**	
Unit II	4
Cognitive Intellectual Development (Vijnanamaya Kosha): Vijnanamaya Kosha : General Introduction, Meaning and Concept. Objectives, Characteristics and Significance. Benefits of developed Vijnanamaya Kosha and deficiencies due to underdeveloped Vijnanamaya Kosha. Means, Activities and Programmes to develop Vijnanamaya Kosha.	
Unit III	8
Cognitive Intellectual Development (Anandamaya Kosha):Anandamaya Kosha : General Introduction, Meaning and Concept. Objectives, Characteristics and Significance. Benefits of developed Anandamaya Kosha and deficiencies due to underdeveloped Anandamaya Kosha. Means, Activities and Programmes to develop Anandamaya Kosha.	
Unit IV	8
Moral Spiritual Development: (To draw inspiration from important events of the lives of great men of India to serve the society and nation). **Social and National Awakening :** Chanakya, Birsa Munda, Lala Lajpat Rai, Jyotiba Phule, Adi Shankaracharya, Veer Savarkar, **Women from other countries dedicated to India :** Annie Besant, Emily Shankle Bose, Mary Reed. **Leading Scientists:** Acharya Sushruta, Acharya Charak, Aryabhatta, Jagdish Chandra Basu, Homi Jahangir Bhabha, A.P.J Abdul Kalam. **Women's Awakening:** Lakshmi Bai, Rani Durgavati, Rani Chenamma, Rani Ahilya Bai Holkar . **Those who sacrificed all:** Bhagat Singh, Khudiram Bose, Chandrashekhar Azad, Mahatma Gandhi. Seekers of Self-reliant India: Vinoba Bhave, Jai Prakash Narayan, Verghese Kurian, M.S.Swaminathan. **Unique Personality of India :** Dr.Rajendra Prasad, Sardar Ballabh Bhai Patel.	

Suggested Reading:

1. My Idea of Education, Swami Vivekanand, Advaita Ashram, Kolkata
2. Rabindranath Tagore : An Interpretation, Sabyasachi Bhattacharya, Penguin Delhi
3. Women Who Created History, NCERT, New Delhi

Semester III

SEMESTER III														
S. No		**BROAD CATEGORY**	**CATEGORY**	**CODE**	**COURSE TITLE**	**Periods**			**Evaluation Scheme**				**Subject Total**	**Credit**
						L	**T**	**P**	**Assignment**	**TA**	**Total**	**ESE**		
1	5	Basic Science Course	Core Courses (CC)-Major	3BSC201	MathematicsIII (Probability & Statistics)	2	0	0	20	10	30	70	100	2
2		Basic ScienceCourse	Core Course (CC)-Minor	3BSC202	Biological Science for Engineers	3	0	0	20	10	30	70	100	3
3		Engineering Science Course	Core Course (CC)-Minor	3ESC201	Analog Electronics Circuit	3	0	0	20	10	30	70	100	3
4		Professional CoreCourse	Core Courses (CC)-Major	3PCCCS201	Data Structure AndAlgorithms	3	0	0	20	10	30	70	100	3
5		Professional Core Course	Core Courses (CC)-Major	3PCCCS202	Computer Organization &Architecture	3	0	0	20	10	30	70	100	3
6		Humanities and Social Science	Ability Enhancement Course (AEC)	3HSMC201	Effective Technical Communication	2	0	0	20	10	30	70	100	2
8		**Mandatory Course**	**Value Added Course (VAC)**	**3UMC102**	**Community Engagement and Social Responsibility**	**1**	**0**	**2**	**40**	**10**	**50**	**50**	**100**	**2**
PRACTICAL /SESSIONAL														
1	5	Engineering Science Course	Core Course (CC)-Minor	3ESC201P	Analog Electronics Circuit Lab	0	0	2			30	20	50	1
2		Professional core Course	Core Courses (CC)-Major	3PCCCS201P	Data Structure And Algorithms Lab	0	0	2			30	20	50	1
3		Professional core Course	Core Courses (CC)-Major	3PCCCS202P	ComputerOrganization & Architecture Lab	0	0	2			30	20	50	1
											TOTAL		**850**	**21**

Program: B.Tech

Semester: Third

Course: Mathematics III (Probability & Statistics)

Course Code: 3BSC201

L	T	P	C
2	0	0	2

Course Objective:

The objectives of this course are:

- To **introduce the fundamental concepts of probability theory**, including probability spaces, conditional probability, and Bayes' rule.
- **To develop understanding of discrete and continuous random variables** along with standard probability distributions such as Binomial, Poisson, and Normal.
- To **impart knowledge of statistical measures** including central tendency, moments, skewness, and kurtosis.
- To **train students in data analysis techniques**, such as correlation, regression, and curve fitting using the method of least squares.

Course Outcome:

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

CO1: Apply the principles of probability to compute conditional probability, independence, and use Bayes' theorem in solving problems.

CO2: Analyze discrete and continuous random variables and use standard distributions (Binomial, Poisson, Normal) to model real-world scenarios.

CO3: Evaluate datasets using statistical tools like moments, skewness, and kurtosis for better decision-making.

CO4: Perform correlation and regression analysis and fit curves to data using the method of least squares.

Course Content:

Topics	Hours
Unit I	9
Probability Probability spaces, conditional probability, independence, Bayes‟ rule, Discrete & Continuous random variables and their properties, Independent random variables, the multinomial distribution, Probability distributions: Binomial, Poisson and Normal distributions, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Chebyshev's Inequality, **Ancient Indian contributions to probability and statistical thinking, use of empirical data in Ayurveda and astronomy, early forms of correlation in astrological predictions, and curve-fitting in Jyotish Shastra for planetary motions.**	
Unit II	6
Statistics Basic Statistics, Measures of Central tendency: Moments, Skewness and Kurtosis, Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves.	

Suggested Text/Reference Books

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, LaxmiPublications, Reprint, 2010.
3. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, UniversalBook Stall, 2003 (Reprint).

Program: B.Tech

Semester: Third

Course: Biological Science for Engineers

Course Code: 3BSC202

L	T	P	C
3	0	0	3

Course Objective:

The objectives of this course are to:

- Recognize and understand the basic cell biology, biomolecules, related metabolic pathways and applicable bioenergetics.
- Relate common biological phenomenon at molecular level.
- Describe the chemical nature of enzymes and mechanism of action for their function in biochemical reactions.
- Correlate the molecular methods of biological signal generation and propagation in living system.
- Comprehend the steps involved in common application of biotechnology such as applicable for creation of transgenics, stem cells, plant metabolites production, PCR, ELISA.

Course Outcome:

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

CO1: Demonstrate an understanding of fundamental biochemical principles, such as the structure/function of biomolecules involved in living system.

CO2: Interpret the bio mechanism involved in signal generation and transmission.

CO3: Correlate the basic methods involved in common biotechnological application.

CO4: Apply and effectively communicate scientific reasoning and data involved in common biotechnological applications.

Course Content:

Topics	Hours
Unit I	
Basic Cell Biology: Origin of life, Cell theory, Cell Structure and function, Biomolecules, Cell cycle and cell division, Biological Organization, **Ayurvedic insights into cell function, metabolism, circadian rhythm, and early Indian contributions to surgery and herbal enzyme applications.**	
Unit II	
Bioenergetics and Metabolism: Gibbs free energy and thermodynamics, aerobic and anaerobic respiration, Glycolysis, Krebs cycle and electron transport chain, Beta oxidation, Photosynthesis.	
Unit III	
Enzymes and its Application: Classification of enzymes, Structure and mechanism of enzyme action and uses of enzymes, factors affecting enzyme activity, Immobilization of enzymes and their application.	
Unit IV	
Biological Signal Generation and Propagation: Nerve cell structure and signal propagation. Mechanism of vision and hearing, cell signaling, Circadian rhythm.	
Unit V	
Engineering Biological Systems and its Applications: Central dogma of molecular biology, Methods in genetic engineering and application, PCR, ELISA and its application, stem cell and tissue engineering. Artificial Intelligence in Biology, Plant factory.	

Books Recommended:

Text Book:

1. Purves et al, (1998) Life: The Science of Biology, 4th Ed.
2. R. Dulbecco, The Design of Life.
3. Lehninger A, Principals of Biochemistry , 5th Ed

Reference Book:

1. Stryer, L. (2002). Biochemistry. New York: W.H. Freeman. [6L]
2. K. Wilson & K.H. Goulding, (2006) A biologist's guide to Principles and Techniques of Practical Biochemistry.

Program: B.Tech

Semester: Third

Course: Analog Electronic Circuits

Course Code: 3ECS201

L	T	P	C
3	0	0	3

Course Objectives:

The objectives of this course are:

- To understand the characteristics of P-N junction and Zener diodes and their applications in basic circuits.
- To analyze the operation of BJTs in switching, biasing, and amplification.
- To study the behavior of MOSFETs and design amplifier circuits using them.
- To explain the working of differential and multistage amplifiers, along with the internal structure of op-amps.
- To design linear analog circuits using op-amps such as filters, oscillators, and voltage regulators.
- To implement and analyze nonlinear analog circuits using op-amps for various applications.

Course Outcomes

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

CO1: Explain diode characteristics and design rectifiers, clippers, and clampers.

CO2: Analyze BJT operation and design small-signal amplifiers.

CO3: Design MOSFET amplifiers and evaluate gain and frequency response.

CO4: Assess differential/multistage amplifiers and op-amp non-idealities.

CO5: Design linear circuits with op-amps (filters, oscillators, regulators).

CO6: Develop nonlinear op-amp circuits (comparators, waveform generators).

Course Content:

Topics	Hours
Unit I	4
Diode circuits P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits, **Insights from ancient Indian texts on natural semiconductors and metallurgy; early analog signal concepts in musical instruments and Ayurvedic pulse diagnostics.**	
Unit II	8
BJT circuits Structure and I- V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common- emitter, common-base and common-collector amplifiers; Small signal equivalent circuits, high- frequency equivalent circuits	
Unit III	8
MOSFET circuits MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.	
Unit IV	8
Differential, multi-stage and operational amplifiers Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)	
Unit V	8
Linear applications of op-amp Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift). Analog to Digital Conversion.	
Unit VI	6
Nonlinear applications of op-amp Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector. Monoshot.	

Text/References:

1. S. Sedra and K. C. Smith, “Microelectronic Circuits”, New York, Oxford University Press, 1998.
2. J. V. Wait, L. P. Huelsman and G. A. Korn, “Introduction to Operational Amplifier theory and applications”, McGraw Hill U. S., 1992.
3. J. Millman and A. Grabel, “Microelectronics”, McGraw Hill Education, 1988.
4. P. Horowitz and W. Hill, “The Art of Electronics”, Cambridge University Press, 1989.
5. P.R. Gray, R.G. Meyer and S. Lewis, “Analysis and Design of Analog Integrated Circuits”, John Wiley & Sons, 2001.

Program: B.Tech

Semester: Third

Course: Analog Electronic Circuits Lab

Course Code: 3ECS201P

L	T	P	C
0	0	2	1

List of Experiment (Analog Electronics Circuit)

1. Verify & simulate the Ohm's Law for Resistance in series by using LabVIEW.
2. Design and simulate P-N junction diode circuit to verify its I-V characteristics byusing simulation software LabVIEW.
3. Design & Verify the Bipolar Junction Transistor for both Common Emitter &common Base.
4. Design and simulate Zener diode circuit to plot Volt-Ampere characteristics by using LabVIEW.
5. Study of basic properties of operational Amplifier:
   A. Inverting
   B. Non- Inverting Amplifier
6. Design & Simulate the Differentiator & Integrator using operational Amplifier byusing LabVIEW.
7. Study the input and output Characteristics of MOSFET.
8. Design & plot the graph of RC Differentiator and Integrator by using LabVIEW.

Program: B.Tech

Semester: Third

Course: Data Structure & Algorithms

Course Code: 3PCCCS201

L	T	P	C
3	0	0	3

Course Objective:

The objectives of this course are:

- To introduce fundamental concepts of data structures and algorithm analysis using basic operations and asymptotic notations.
- To understand and implement linear data structures like arrays, stacks, queues, and linked lists.
- To explore non-linear data structures such as trees and graphs with relevant algorithms.
- To analyze and apply efficient sorting and hashing techniques for computational problems.

Course Outcome

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

CO1: Apply basic data structure operations such as insertion, deletion, and traversal, and analyze algorithm complexity using asymptotic notations.

CO2: Implement and evaluate linear data structures like stacks, queues, and linked lists for expression evaluation and dynamic memory management.

CO3: Design and analyze non-linear data structures including binary trees, AVL trees, and graphs for optimized data organization and retrieval.

CO4: Demonstrate the ability to implement various sorting and hashing techniques, and assess their efficiency using time and space complexity analysis

Course Content:

Topics	Hours
Unit I	9
Introduction: Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. **Searching:** Linear Search and Binary Search Techniques and their complexity analysis, **Ancient Indian algorithms like Pingala's binary system and Panini's grammar rules as early forms of structured data and rule-based computation.**	
Unit II	8
Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queues: Simple Queue, Circular Queue, Priority Queue; Operations on each type of Queues: Algorithms and their analysis.	
Unit III	10
Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis. **Trees:** Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+Tree: definitions, algorithms and analysis	
Unit IV	**8**
Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing. **Graph:** Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.	

Suggested books:

1. "Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.
2. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company "How to Solve it by Computer", 2nd Impression by R.G. Dromey, PearsonEducation.

Program: B.Tech

Semester: Third

Course: Data Structure & Algorithms Lab

Course Code: 3PCCCS201P

L	T	P	C
0	0	2	1

Program:

1. To read and display n numbers using an array.
2. To find transpose a 3 X 3 matrix.
3. To insert a number at a given location in an array.
4. To delete a number from a given location in an array.
5. To create a linked list
6. To create a linked list and perform insertions:
   a) at beginning b) at end c) before a given node
7. To create a linked list and perform deletions:
   a) from beginning b) from end c) at a given node
8. To create a circular linked list and perform insertion at the beginning of list.
9. To create a circular linked list and perform insertion at the end of list.
10. To perform Push, Pop and Peep operations on a stack.
11. To implement a linear queue.
12. To implement a priority queue.
13. To search an element in an array using linear search technique.
14. To search an element in an array using binary search technique.
15. To sort an array using insertion sort algorithm.
16. To implement quick sort algorithm.
17. To sort an array using bubble sort algorithm.

Program: B.Tech

Semester: Third

Course: Computer Organization & Architecture

Course Code: 3PCCCS202

L	T	P	C
3	0	0	3

Course Objective:

The objectives of this course are:

- To understand the functional blocks of a computer system, instruction set architecture, data representation, and arithmetic operations.
- To study the design of CPU control units, x86 architecture, memory systems, and I/O subsystems.
- To explore pipelining techniques and gain insights into parallel processors and memory access challenges.
- To analyze memory organization techniques, including cache design, mapping functions, and replacement policies.

Course Outcome:

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

CO1: Describe computer system components, instruction set architecture, and perform operations using various data and arithmetic representations.

CO2: Analyze CPU control unit designs, x86 architecture, and I/O transfer mechanisms including interrupts and DMA.

CO3: Explain pipelining concepts and assess performance improvements and hazards in instruction execution.

CO4: Evaluate memory hierarchy, cache mapping techniques, and policies for efficient memory organization.

Course Content:

Topics	Hours
Unit I	10
Functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU–registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Case study – instruction sets of some common CPUs **Data representation**: signed number representation, fixed and floating-point representations, character representation. Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look- ahead adder, etc. multiplication – shift-and add, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic, **Study of early Indian computation systems such as Shunya (zero) concept, binary logic in Pingala's Chandas Shastra, and ancient numeral systems influencing modern computer arithmetic.**	
Unit II	9
Introduction to x86 architecture. **CPU control unit design**: hardwired and micro-programmed design approaches, Case study – design of a simple hypothetical CPU. **Memory system design**: semiconductor memory technologies, memory organization. **Peripheral devices and their characteristics**: Input-output subsystems, I/O device interface, I/O transfers–program controlled, interrupt driven and DMA, privileged and non- privileged instructions, software interrupts and exceptions. Programs and processes–role of interrupts in process state transitions, I/O device interfaces – SCII, USB	
Unit III	6
Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards.	
Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency.	
Unit IV	5
Memory organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.	

Suggested books:

1. "Computer Organization and Design: The Hardware/Software Interface",5th Edition by David A. Patterson and John L. Hennessy, Elsevier.
2. "Computer Organization and Embedded Systems", 6th Edition byCarlHamacher, McGraw Hill Higher Education.

Suggested reference books:

1. "Computer Architecture and Organization", 3rd Edition by John P. Hayes,
2. WCB/McGraw-Hill
3. "Computer Organization and Architecture: Designing for Performance",10th Edition by William Stallings, Pearson Education.
4. "Computer System Design and Architecture", 2nd Edition by Vincent P.Heuring and Harry F. Jordan, Pearson Education.

Program: B.Tech

Semester: Third

Course: Computer Organization & Architecture Lab

Course Code: 3PCCCS202P

L	T	P	C
0	0	2	1

List of Experiments:

1. To design the circuit of half adder.
2. To design the circuit of full adder.
3. To design the circuit of half subtractor.
4. To design the circuit of full subtractor.
5. To design an 8×1 Multiplexer.
6. To design a 4 bit combinational shifter.
7. To design a BCD adder.
8. To design a 4-bit adder subtractor.
9. To design 2:4 Decoder
10. Write the working of 8085 simulator GNUsim8085 and basic architecture of 8085along with small introduction.
11. Study the complete instruction set of 8085 and write the instructions in the instructionset of 8085 along with examples.
12. Write an assembly language code in GNUsim8085 to implement data transfer instruction.
13. Write an assembly language code in GNUsim8085 to store numbers in reverse orderin memory location.
14. Write an assembly language code in GNUsim8085 to implement arithmetic instruction.
15. Write an assembly language code in GNUsim8085 to find the factorial of a number.

Program: B.Tech

Semester: Third

Course: Effective Technical Communication

Course Code: 3HSMC201

L	T	P	C
2	0	0	2

Course Objective:

The objectives of this course are:

- To teach students the principles of technical communication for their academic and professional needs, focusing on essential written and oral skills for presenting technical information effectively.
- To make the students aware of the basic principles, which include the analysis of context, purpose and audience.
- To enhance fundamentals of technical report writing.
- To equip their effective technical presentations.

Course Outcome:

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

CO1: Be able to grasp the ideas and information put across in a communication situation.

CO2: To get a proper hold on communication techniques needed in a situation.

CO3: Have soft skills to work in a team for organizational development.

CO4: Be able to analyze information and interpret a case study for application.

CO5: To form simple reports and projects for organizational needs.

Course Content:

Topics	Hours
Unit I	5
Information Design and Development- Different kinds of technical documents, Information development life cycle, Organization structures, factors affecting information and document design, Strategies for organization, Information design and writing for print and for online media, **Incorporating ancient Indian techniques like *śabda*, *Nāṭyaśāstra* expressions, and traditional letter formats to enrich clarity and empathy in technical communication.**	
Unit II	7
Technical Writing, Grammar and Editing- Technical writing process, forms of discourse, Writing drafts and revising, Collaborative writing, creating indexes, technical writing style and language. Basics of grammar, study of advanced grammar, editing strategies to achieve appropriate technical style. Introduction to advanced technical communication, Usability, Hunan factors, Managing technical communication projects, time estimation, Single sourcing, Localization.	
Unit III	5
Self-Development and Assessment- Self assessment, Awareness, Perception and Attitudes, Values and belief, Personal goal setting, career planning, Self-esteem. Managing Time; Personal memory, Rapid reading, Taking notes; Complex problem solving; Creativity.	
Unit IV	4
Communication and Technical Writing- Public speaking, Group discussion, Oral; presentation, Interviews, Graphic presentation, Presentation aids, Personality Development. Writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes, business letters, memos, progress reports, minutes of meetings, event report.	
Unit V	3
Ethics- Business ethics, Etiquettes in social and office settings, Email etiquettes, Telephone Etiquettes, Engineering ethics, Managing time, Role and responsibility of engineer, Work culture in jobs, Personal memory, Rapid reading, Taking notes, Complex problem solving, Creativity.	

Suggested Readings:

1. David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York, 2004
2. Diane Hacker, Pocket Style Manual, Bedford Publication, New York, 2003. (ISBN 0312406843)
3. Shiv Khera, You Can Win, Macmillan Books, New York, 2003.
4. Raman Sharma, Technical Communications, Oxford Publication, London, 2004.
5. Dale Jungk, Applied Writing for Technicians, McGraw Hill, New York, 2004. (ISBN: 07828357-4)
6. Sharma, R. and Mohan, K. Business Correspondence and Report Writing, TMH New Delhi 2002

Program: B.Tech

Semester: Third

Course: Community Engagement and SocialResponsibility

Course Code: 3UMC102

L	T	P	C
1	0	2	2

Course Objective:

The objectives of this course are:

- To develop an appreciation of rural culture, life-style and wisdom amongststudents.
- To learn about the status of various agricultural and rural development programmes.
- To understand causes for rural distress and poverty and explore solutions for thesame.
- To apply classroom knowledge of courses to field realities and thereby improvequality of learning.

Course Outcomes:

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

CO1: Gain an understanding of rural life, culture and social realities.

CO2: Develop a sense of empathy and bonds of mutuality with local community.

CO3: Appreciate significant contributions of local communities to Indian society andeconomy.

CO4: Learn to value the local knowledge and wisdom of the community.

CO5: Identify opportunities for contributing to community's socio-economicimprovements.

Course Content:

Topics	Hours
Unit	8
Appreciation of Rural Society	
Rural life style, rural society, caste and gender relations, rural values with respect to community, nature and resources, elaboration of "soul of India lies in villages" (Gandhi), rural infrastructure, **Incorporates Gandhian philosophy of Gram Swaraj, traditional self-governance, indigenous rural practices, and community-centric development rooted in Indian knowledge systems.** **ASSIGNMENT:** Prepare a map (physical, visual or digital) of the village you visited and write an essay about inter-family relations in that village, Insights from Gandhian philosophy on Gram Swaraj, indigenous community practices, and traditional rural self-governance models to strengthen local development and social harmony.	
Unit II	6
Understanding rural economy & livelihood Agriculture, farming, landownership, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural markets. **ASSIGNMENT:** Describe your analysis of rural h o u s e h o l d economy, its challenges and possible pathways to address them.	
Unit III	8
Rural Institutions Traditional rural organisations, Self-help Groups, Panchayati raj institutions (Gram Sabha, Gram Panchayat, Standing Committees), local civil society, local administration. **ASSIGNMENT:** How effectively are Panchayati raj institutions functioning in the village? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual)	
Unit IV	8
Rural Development Programmes History of rural development in India, current national programmes: Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swatchh Bharat, PM Awaas Yojana, Skill India, Gram Panchayat Decentralized Planning, NRLM, MNREGA, etc **ASSIGNMENT:** Describe the benefits received and challenges faced in the delivery of one of these programmes in the rural community; give suggestions about improving Implementation of the programme for the rural poor.	

Suggested Readings:

1. Singh, Katar, Rural Development: Principles, Policies and Management, Sage Publications, New Delhi, 2015.

3. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati

4. Raj Studies, 2002.

5. United Nations, Sustainable Development Goals, 2015 un.org/sdgs/

6. M.P.Boraian, Best Practices in Rural Development, Shanlax Publishers, 2016

JHARKHAND Rai University RANCHI

SEMESTER IV

SEMESTER IV														
S.No.		**BROAD CATEGORY**	**CATEGORY**	**CODE**	**COURSE TITLE**	**Periods**			**Evaluation Scheme**				**Subject Total**	**Credit**
						L	**T**	**P**	**Assignment**	**TA**	**Total**	**ESE**		
1	5	Engineering ScienceCourse	Core Course (CC)-Minor	3ESC202	Digital Electronics	3	0	0	20	10	30	70	100	3
2		Professional CoreCourse	Core Courses (CC)-Major	3PCCCS203	Object Oriented Programming with JAVA	3	0	0	20	10	30	70	100	3
3		Professional CoreCourse	Core Courses (CC)-Major	3PCCCS204	Discrete Mathematics	3	1	0	20	10	30	70	100	4
4		Professional CoreCourse	Core Courses (CC)-Major	3PCCCS205	Design & Analysis of Algorithms	3	0	0	20	10	30	70	100	3
5		Humanities andSocial Sciences	Skill Enhancement Course (SEC)	3HSMC203	Entrepreneurship	3	0	0	20	10	30	70	100	3
6		Value Added Course	Value Added Course (VAC)	3VAC201	Character Building & Holistic Development of Personality-II (Yoga and Physical Fitness)	2	0	0	20	10	30	70	100	2
PRACTICAL /SESSIONAL														
1	5	Engineering ScienceCourse	Core Course (CC)-Minor	3ESC202P	Digital Electronics Lab	0	0	2			30	20	50	1
2		Professional Core Course	Core Courses (CC)-Major	3PCCCS205P	Design & Analysis of Algorithms Lab	0	0	2			30	20	50	1
3		Professional Core Course	Core Courses (CC)-Major	3PCCCS203P	Object Oriented Programming with JAVA Lab	0	0	2			30	20	50	1
											TOTAL		**850**	**21**
NOTE: Mandatory Vocational /Industrial Training(4Weeks) or any specialized course of minimum 4 credits offered by respective department for student opting for exit after second year with UG DIPLOMA														

Program: B.Tech

Semester: Fourth

Course: Digital Electronics

Course Code: 3ESC202

L	T	P	C
3	0	0	3

Course Objective:

The objective of this course is:

- To introduce the fundamentals of digital systems and logic families,(number systems, Boolean algebra, and digital IC characteristics).
- To develop the ability to design and simplify combinational logic circuits using Karnaugh maps and MSI components like adders, encoders, and decoders.
- To provide knowledge of sequential circuits (flip-flops, registers, and counters, and their applications in digital systems.)
- To explain the principles and types of A/D and D/A converters, and their implementation using standard ICs.
- To familiarize students with memory systems and programmable logic devices, including ROM, RAM, PLAs, PALs, CPLDs, and FPGAs.

Course Outcome:

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

CO1: Understand digital signals, logic gates, Boolean algebra, number systems, and the characteristics of digital ICs and logic families.

CO2: Design and minimize combinational logic circuits using K-map and implement them using standard MSI devices.

CO3: Analyze and implement sequential circuits such as flip-flops, shift registers, and counters for various digital applications.

CO4: Explain the working of different types of A/D and D/A converters and evaluate their performance parameters.

CO5: Demonstrate understanding of memory organization and programmable logic devices and apply them in basic digital system design.

Course Content:

Topics	Hours
Unit I	7
Fundamentals of Digital Systems and logic families Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive- OR operations, Boolean algebra, examples of ICgates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic, **Introduction to binary logic systems in ancient Indian mathematics (Pingala's binary system) and philosophical insights on logic from Nyaya Sutras.**	
Unit II	7
Combinational Digital Circuits Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De- Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization	
Unit III	**7**
Sequential circuits and systems A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T and D- types flip-flops, applications of flip-flops, shift registers, applications of shift registers ,serialtoparallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.	
Unit IV	7
A/D and D/A Converters Digital to analog converters: weighted resistor/converter, R- 2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter lCs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using Voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs	
Unit V	7
Semiconductor memories and Programmable logic devices Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).	

Suggested Reading:

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India,2016.
3. A.Kumar, "Fundamentals of Digital Circuits", Prentice Hall India

Program: B.Tech

Semester: Fourth

Course: Digital Electronics Lab

Course Code: 3ESC202P

L	T	P	C
0	0	2	1

List of Experiment:

1. To illustrate & verify the working of AND, OR & NOT GATE.
2. To illustrate & verify the working of Exclusive OR & Exclusive NOR GATE
3. To illustrate & verify the working of NAND & NOR GATE
4. To Demonstrate the De-Morgan's Theorm.
5. To illustrate the working of Full adder & Half adder using various logic GATES.
6. To illustrate the working of Full subtractor & Half subtractor using various logic GATES.
7. To study IC 7404, IC 7432& IC 740 and verify the AND, OR & NOT GATE presence init.

Program: B.Tech

Semester: Fourth

Course: Object Oriented Programming with Java

Course Code: 3PCCCS203

L	T	P	C
3	0	0	3

Course Objective:

The objective of this course is:

- To introduce the Java environment, program structure, data types, and operators.
- To develop control flow logic using decision-making and looping constructs.
- To apply object-oriented programming concepts such as classes, objects, inheritance, arrays, and interfaces.
- To demonstrate the use of multithreading, applet development, and package handling in Java applications.

Course Outcome:

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

CO1: Describe Java syntax, data types, operators, and variable management.

CO2: Construct Java programs using control structures and expressions.

CO3: Implement object-oriented solutions with inheritance, arrays, strings, and interfaces.

CO4: Develop Java applications with multithreading, applets, and system packages.

Course Content:

Topics	Hours
Unit I	5
JAVA environment. JAVA program structure, Tokens, Statements, JAVA virtual machine, Constant & Variables, Data Types, declaration of Variables, Scope of Variables, Symbolic Constants, Type Casting. Operators: Arithmetic, Relational, Logical Assignments, Increment and Decrement, Conditional, Bitwise, Special, **Incorporation of logical structuring and object categorization inspired by Indian philosophical systems like Nyaya and Vaisheshika for class and object modeling.**	
Unit III	6
Expressions & its evaluation. If statement, if…else… statement, Nesting of if…else… statements, else…if Ladder, Switch, ?operators, Loops –While, Do, For, Jumps in Loops, Labeled Loops. Defining a Class, Adding Variables and Methods.	
Unit III	10
Creating Objects, Accessing Class Members, Constructors, Methods Overloading, Static Members, Nesting of Methods. Inheritance: Extending a Class, Overriding Methods, Final Variables and Methods, Final Classes, Finalize Methods, Abstract methods and Classes, Visibility Control. Arrays: One Dimensional & two Dimensional, strings, Vectors, wrapper Classes, Defining Interface Extending Interface, Implementing Interface, Accessing Interface Variable, System Packages, Using System Package Adding a Class to a Package, Hiding Classes.	
Unit IV	9
Creating Threads, Extending the Threads Class, Stopping and Blocking a Thread, Life Cycle of a Thread, Using Thread Methods, Thread Exceptions, Thread Priority, Synchronization, Implementing the Executable Interface. Local and Remote Applets Vs Applications, Writing Applets, Applets Life Cycle, Creating an Executable Applet, Designing a Web Page, Applet Tag, Adding Applet to HTML File, Running the Applet, Passing Parameters to Applets, Aligning the Display, HTML Tags & Applets ,Getting Input from the User.	

Suggested Readings:

1. Programming with Java, E.Balaguruswamy, TMH.

2. Core Javafor beginners, RASHMI Kanta Das, Vikas pub.

Program: B.Tech

Semester: Fourth

Course: Object Oriented Programming with Java Lab

Course Code: 3PCCCS203P

L	T	P	C
0	0	2	1

List of Experiment:

1. Program to find square root of given number
2. Program to enter principal, rate & time and find simple interest
3. Program to find whether a year is leap year or not
4. Program to enter a number from keyboard and find out Fibonacci series
5. Program to enter a number from keyboard and find out factorial of the number
6. Program to enter a number from keyboard and check whether the number is palindrome ornot
7. Program to enter a number from keyboard and print the prime numbers present within it
8. Program to enter a number from keyboard and determine whether it is Armstrong or not.
9. Program to demonstrate switch statement
10. To swap two numbers without using third variable
11. To find the greatest among 3 numbers
12. Program to sort an array in an ascending order
13. Program to find out the sum and average of the elements present in an array
14. Program to add the elements of two different two dimensional array.
15. Program to find out the biggest and smallest number from a matrix.
16. Program to implement the concept of final class
17. Program to o implement the concept of interface
18. Program to reverse a specified string.
19. Write a program in java to show the user defined package.
20. Program to create an applet
21. Program to implement the concept of thread

Program: B.Tech

Semester: Fourth

Course: Discrete mathematics

Course Code: 3PCCCS204

L	T	P	C
3	1	0	4

Course Objectives:

The objective of this course is:

- To understand sets, relations, and functions with applications in modeling and computing.
- To apply induction, number theory, and combinatorics in problem solving.
- To develop reasoning skills using propositional and predicate logic.
- To study algebraic structures and their role in abstract systems and logic design.
- To analyze graphs and trees for solving problems in connectivity and optimization.

Course Outcomes

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

CO1: Apply set theory, relations, and functions to solve mathematical problems and model real-world scenarios in computing.

CO2: Solve problems using mathematical induction, the Euclidean algorithm, and basic combinatorial techniques like the pigeonhole principle and permutations.

CO3: Demonstrate understanding of propositional logic and quantifiers, and construct valid arguments using various proof methods.

CO4: Analyze and apply algebraic structures such as groups, rings, and Boolean algebra in mathematical reasoning and digital logic.

CO5: Utilize properties of graphs and trees to model networks, compute shortest paths, and perform graph coloring and traversal algorithms.

Course Content:

Topics	Hours
Unit I	10
Module 1: Sets, Relation and Function Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum and Product of Functions, Bijective functions, Inverse and Composite Function, Size of a Set, Finite and infinite Sets, Countable and uncountable Sets, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem**, Study of logical reasoning and number theory in ancient Indian texts like *Nyaya Sutras* and *Pingala's Chandashastra*, including early combinatorics and binary systems.**	
Unit II	8
Principles of Mathematical Induction The Well-Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic. Basic counting techniques-inclusion and exclusion, pigeon-hole principle, permutation and combination.	
Unit III	7
Propositional Logic Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. **Proof Techniques:** Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.	
Init IV	9
Module 4: Algebraic Structures and Morphism Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form	
Unit V	6
Module 5: Graphs and Trees Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Colouring, Colouring maps and Planar Graphs, Colouring Vertices, Colouring Edges, List Colouring, Perfect Graph, definition properties and Example, rooted trees, trees and sorting, weighted trees and prefix codes, Bi- connected component and Articulation Points, Shortest distances.	

Suggested readings:

1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structure and It's Application to Computer Science‖, TMG Edition, TataMcgraw-Hill
2. Norman L. Biggs, Discrete Mathematics, 2nd Edition, Oxford University Press. Schaum's Outlines Series, Seymour Lipschutz, Marc Lipson,
3. Discrete Mathematics, Tata McGraw - Hill

Program: B.Tech

Semester: Fourth

Course: Design and Analysis of Algorithms

Course Code: 3PCCCS205

L	T	P	C
3	0	0	3

Course Objectives:

The objective of this course is:

- To understand algorithm characteristics and analyze time and space complexity.
- To learn fundamental algorithm design strategies for problem-solving.
- To study graph and tree algorithms for solving computational problems.
- To explore complexity classes and the concept of algorithmic tractability.
- To introduce advanced algorithmic techniques beyond NP.

Course Outcome:

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

CO1: Analyze algorithm efficiency using asymptotic notations and recurrence relations.

CO2: Apply brute-force, greedy, dynamic programming, and backtracking techniques.

CO3: Implement graph algorithms like DFS, BFS, shortest paths, MST, and topological sorting.

CO4: Classify problems into P, NP, NP-complete, and NP-hard using reduction techniques.

CO5: Design approximate and randomized algorithms and understand PSPACE complexity.

Course Content:

Topics	Hours
Unit I	8
Introduction Introduction: Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade- offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem, **Exploration of algorithmic concepts in ancient Indian texts, such as Panini's grammar rules (as formal systems) and the use of step-wise logic in Vedic mathematics**	
Unit II	8
Fundamental Algorithmic Strategies Fundamental Algorithmic Strategies: Brute -Force, Greedy, Dynamic Programming, Branch-and-Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem- Solving , Bin Packing, Knap Sack TSP. Heuristics – characteristics and their application domains.	
Unit III	5
Module 3: Graph and Tree Algorithms Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS), Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.	
Unit IV	4
Tractable and Intractable Problems Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP- complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques.	
Unit V	5
Advanced Topics Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE	

Text/Reference Books:

1. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson,Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill. Fundamentals of Algorithms – E. Horowitz et al.
2. Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson. AlgorithmDesign: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley. Algorithms—A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA.

Program: B.Tech

Semester: Fourth

Course: Design and Analysis of Algorithms Lab

Course Code: 3PCCCS205P

L	T	P	C
0	0	2	1

List of Experiment:

1. To implement Binary Search.
2. To implement Longest Common Subsequence (LCS).
3. To implement Matrix Chain Multiplication (MCM).
4. To implement Travelling Salesman Problem (TSP)
5. To implement MST using Kruskal's algorithm.
6. To implement MST using Prim's algorithm.
7. To implement DFS on a graph.
8. To implement BFS on a graph
9. To implement Dijkstra algorithm.
10. To implement 0/1 knapsack problem.
11. To implement Quick sort.
12. To implement Merge sort.
13. To implement Huffman Coding technique.
14. To implement All Pairs Shortest Path Problem(i.e Floyd-Warshall Algorithm)

Program: B.Tech

Semester: Fourth

Course: Character Building & Holistic Development of Personality- II (Yoga and Physical Fitness)

Course Code: 3VAC201

L	T	P	C
2	0	0	2

Course Objective:

The objective of this course is:

- To generate awareness among students about health and yoga.
- To encourage students to be environmentally conscious, conserve water and practise good hygiene.
- To acquaint the students with the fundamental principles of national unity and integration through practicing yoga.
- To develop Annamaya Kosha (Physical Development) and Pranamaya Kosha (Development of Prana).

Course Outcome:

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

CO1: Develop a strong understanding of spiritual and mental health.

CO2: Apply the concept of sustainability and development.

CO3: Understand the importance of Yoga and integrate its practice into daily life.

CO4: Develop their Annamaya Kosha and Pranamaya Kosha.

Course Content:

Topics	Hours
Unit I	
Physical Vital Development: Physical Vital Development: Health: Meaning, Concept, Dimensions of health (mental, physical, social and spiritual) and health related general habits. **Ideal daily routine/ Lifestyle**: Meaning, Concept, Principles and its related practice. **Balanced Diet:** Meaning, Concept, Benefits, Alkali and Acid, Balanced Diet according to Desh (location), Kaal (time), Ayu (age) and Ritu (season). **Ritucharya (Seasonal Habits)**: Meaning, general Introduction, Concept, Month and Festivities according to season, Nature of Earth, Lifestyle according to Shishir Season. **Sukshama Vyayama and Surya Namaskara** : General Introduction, Precautions and Practice, **Study of Ritucharya (seasonal regimens) and balanced diet concepts from Ayurveda, as well as yogic practices from ancient Indian scriptures like Patanjali Yoga Sutras and Hatha Yoga Pradipika**.	4
Unit II	
Yoga and its Importance: Yoga: Meaning, Concept, Aims and Objectives, Types. Diet and Health: Conditions, Malnutrition (Undernutrition and Over Nutrition) causes, Problems and Solutions, Common points of consideration for nutrition. Vasant Ritucharya: Lifestyle according to Spring season; Lifestyle- General Introduction, Concept, Month and Festivities according to season. Pranayama: General Introduction (Bandh, Nadi and Chakra), Importance, Eligibility, Time, Place, position, Principles of Practice and Precautions, Asana: General Introduction, Types, Benefits, Precaution and Practice (Asanas in Standing position) Practice of Sukshama Vyayama and Surya Namaskara	4
Unit III	
Yoga and Physical Fitness: Yoga and its Importance: Yoga: Meaning, Concept, Aims and Objectives, Types. Diet and Health: Conditions, Malnutrition (Undernutrition and Over Nutrition) causes, Problems and Solutions, Common points of consideration for nutrition. **Vasant Ritucharya:** Lifestyle according to spring season; Lifestyle- General Introduction, Concept, Month and Festivities according to season. Pranayama: General Introduction (Bandh, Nadi and Chakra), Importance, Eligibility, Time, Place, position, **Principles of Practice and Precautions.Asana:** General Introduction, Types, Benefits, Precaution and Practice (Asanas in Standing position).Practice of Sukshama Vyayama and Surya Namaskara	8
Unit IV	
Practices of Yoga: Sharad Ritucharya: Lifestyle according to Autumn season- General Introduction, Concept, Month and Festivities according to season, Nature of the Earth. Pranayama: Importance, Rules, Precautions and Practice of Chandrabhedi, Suryabhedi and Ujjai Pranayama. Asanas: (asanas performed in Supine position) - General Introduction, Benefits, Precautions and practice. **Practice of Sukshama Vyayama and Surya Namaskara. Hemant Ritucharya:** According to Hemant season- Meaning, General Introduction, Concept, Month and Festivities according to season, **Nature of the Earth. Pranayama**: Importance, Rules, **Precautions and Practices of Sheetali, Sheetkari and Nadi Shodhan Pranayama.Asanas:** (asanas performed in Prone position) - General Introduction, Benefits, Precautions and practice. Practice of Sukshama Vyayama and Surya Namaskara,Self Defense: Meaning, Purpose, Required Capabilities; Relaxation: Shoulder-movement exercise for Spine & maintaining the balance, **Marmasthala – Common Vulnerable/Vital Points ,Prahara** : Meaning, Striking Organs, Types of Strikes, Precautions. Preventing possible strikes, Preventing Organs and types/uses	8

Suggested Readings:

1. Yoga for Everyone, B.K.S.Iyengar, Dorling Kindersley Ltd; New Delhi
2. Yoga the Path to Holistic Health, .B.K.S.Iyengar, Dorling Kindersley Ltd; New Delhi
3. Science of Yoga, Ann Swanson, Dorling Kindersley Ltd; New Delhi

Program: B.Tech

Semester: Fourth

Course: Entrepreneurship

Course Code: 3HSMC203

L	T	P	C
3	0	0	3

Course Objective:

The objective of this course is:

- To understand the fundamentals of projects, types, identification, life cycle, and organizational structures.
- To learn social cost-benefit analysis using the UNIDO approach and apply network techniques like PERT and CPM.
- To gain knowledge of capital budgeting methods and project control systems.
- To understand the significance of entrepreneurship and institutional support in economic development.
- To learn the business life cycle and steps to establish a new industry.

Course Outcome:

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

CO1: Understand project concepts, types, characteristics, life cycle, and steps for successful implementation.

CO2: Analyze technical, financial, market, and economic feasibility; differentiate CBA and SCBA; model and evaluate projects using PERT, CPM, and optimization techniques.

CO3: Evaluate capital budgeting using NPV, IRR, PI, ARR, and Payback methods.

CO4: Understand entrepreneurship development and the role of institutions; analyze factors affecting the success or failure of new ventures.

Course Content:

Topics	Hours
Unit-I	4
Introduction to Project Management Concept, characteristics of projects, types of projects, project identification, and Project's life cycle, Forms of Project Organization, Human Aspects of Project Management, Pre-requisites for Successful Project Implementation, **Study of traditional Indian entrepreneurship practices, indigenous project planning techniques from Arthashastra, and integration of dharmic ethics in business decisions.**	
Unit-II	8
Project Feasibility Market feasibility, technical feasibility, financial feasibility, and economic feasibility, social cost-benefit analysis, project risk analysis Network Analysis, Requirements for Network Analysis, Critical Path Method (CPM), Programme Evaluation and Review Technique (PERT)	
Unit-III	8
Financial appraisal/evaluation techniques Estimation of Cash Flows, discounted/non-discounted cash flows; Net present values, profitability index, Internal rate of returns; Cost benefits ratio; Accounting rate of return, Payback period, Project implementation; Cost overrun, Project control and information system	
Unit IV	10
Entrepreneurship Development Significance of entrepreneurship in economic development qualities of entrepreneur, entrepreneurship development programs and role of various institutions in developing entrepreneurship, life cycles of new business, environmental factors affecting success of a new business, reasons for the failure and visible problems for business, Developing effective business plans, Procedural steps in setting up of an industry	

Suggested Reading:

1. Chandra P. 2005. Project Management. Tata McGraw Hill.13
2. Gopal Krishan P & Nagarajan K. 2005. Project Management. New Age.
3. Hisrich RD & Peters MP. 2002. Entrepreneurship. Tata McGraw Hill.
4. Kaplan JM. 2003. Patterns of Entrepreneurship. John Wiley & Sons.
5. Nandan H. 2007. Fundamentals of Entrepreneurship Management. Prentice Hall.
6. Ramamoorthy VE. 2005. Textbook of Project Management. MacMillan

Semester V

SEMESTER V														
S. No		**BROAD CATEGORY**	**CATEGORY**	**CODE**	**COURSE TITLE**	**Periods**			**Evaluation Scheme**				**Subject Total**	**Credit**
						L	**T**	**P**	**Assignment**	**TA**	**Total**	**ESE**		
1	5.5	Professional Core Course	Core Courses (CC)-Major	3PCCCS301	Database Management Systems	3	0	0	20	10	30	70	100	3
2		Professional Core Course	Core Courses (CC)-Major	3PCCCS302	Formal Language & Automata Theory	3	0	0	20	10	30	70	100	3
3		Professional Core Course	Core Courses (CC)-Major	3PCCCS304	IT Workshop (Sci Lab/MATLAB)	2	0	0	20	10	30	70	100	2
4		Professional Core Course	Core Courses (CC)-Major	3PCCCS305	Operating Systems	3	0	0	20	10	30	70	100	3
5		Track Elective	Core Courses (CC)-Major		Track Elective - 1	3	0	2	20	10	30	70	150	4
6		Value Added Course	Value Added Course (VAC)	3VAC301	Character Building & Holistic Development of Personality- III (Universal Human Values and Ethics)	2	0	0	20	10	30	70	100	2
7		Internship	Internship	3INT301	Internship	0	0	4				100	100	2
PRACTICAL /SESSIONAL														
1	5.5	Professional Core Course	Core Courses (CC)-Major	3PCCCS301P	Database Management Systems Lab	0	0	2			30	20	50	1
2		Professional Core Course	Core Courses (CC)-Major	3PCCCS304P	IT Workshop (Sci Lab/MATLAB)	0	0	2			30	20	50	1
3		Professional CoreCourse	Core Courses (CC)-Major	3PCCCS305P	Operating Systems Lab	0	0	2			30	20	50	1
											TOTAL		**900**	**22**

Program: B.Tech

Semester: Fifth

Course: Database Management Systems

Course Code: 3PCCCS301

L	T	P	C
3	0	0	3

Course Objective:

The objectives of this course are:

- **To understand** the fundamental architecture of database systems, including data abstraction, data models, and query languages.
- **To explore** relational database design principles, including normal forms, dependency theory, and lossless design.
- **To apply** relational query languages like relational algebra, SQL, and relational calculus in solving real-time data problems.
- **To examine** query processing, optimization techniques, and storage strategies such as indexing and hashing.
- **To analyze** transaction management, concurrency control mechanisms, database recovery techniques, and security models.

Course Outcome:

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

CO1: Demonstrate knowledge of database system architecture, data models, and DDL/DML operations.

CO2: Apply relational algebra and SQL queries to retrieve and manipulate data from a database.

CO3: Design efficient and normalized relational databases using concepts like functional dependencies and normal forms.

CO4: Evaluate and optimize database queries using join strategies, indexing, and query processing algorithms.

CO5: Analyze and implement database transaction controls, concurrency mechanisms, and security features like access control and SQL injection prevention.

Course Content:

Topics	Hours
Unit I	6
Database system architecture: Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML). **Data models:** Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations, **Exploration of ancient Indian data recording systems such as palm leaf manuscripts and temple records, emphasizing indigenous methods of data organization and preservation**.	
Unit II	8
Relational query languages: Relational algebra, Tuple and domain relational calculus, SQL3,DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2,SQL server. **Relational database design:** Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Lossless design. **Query processing and optimization:** Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.	
Unit III	5
Storage strategies: Indices, B-trees, hashing.	
Unit IV	6
Transaction processing: Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery.	
Unit V	5
Database Security: Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.	

Suggested books:

1. "Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F.Korth, S.Sudarshan, McGraw-Hill.
2. Introduction to Database. Systems. Bipin C. Desai. Concordia University. Montreal, Canada. West Publishing Company. St. Paul New York Los Angeles San

Suggested reference books

1 "Principles of Database and Knowledge – Base Systems", Vol 1 by J. D.Ullman, Computer Science Press.

2 "Fundamentals of Database Systems", 5th Edition by R. Elmasri and S.Navathe,Pearson Education

3 "Foundations of Databases", Reprint by Serge Abiteboul, Richard Hull, VictorVianu, Addison-Wesley

Program: B.Tech

Semester: Fifth

Course: Database Management Systems Lab

Course Code: 3PCCCS301P

L	T	P	C
0	0	2	1

List of Programs as Assignments:

Lab Assignment No: 1

Objective: Implementation of DDL commands of SQL with suitable examples

- Create table
- Alter table
- Drop Table

Lab Assignment No: 2

Objective: Implementation of DML commands of SQL with suitable examples

- Insert
- Update
- Delete

Lab Assignment No: 3

Objective: Implementation of different types of function with suitable examples

- Number function
- Aggregate Function
- Character Function
- Conversion Function
- Date Function

Lab Assignment No: 4

Objective: Study & Implementation of PL/SQL.

Lab Assignment No: 5

Objective Implementation of different types of operators in SQL

- Arithmetic Operators
- Logical Operators
- Comparison Operator
- Special Operator
- Set Operation

Lab Assignment No: 6

Objective: Implementation of different types of Joins

- Inner Join
- Outer Join
- Natural Join etc..

Lab Assignment No: 7

Objective: Study & Implementation of SQL Triggers.

Lab Assignment No: 8

Objective:

- Creating Database /Table Space
- Managing Users: Create User, Delete User
- Managing roles:-Grant, Revoke.

Lab Assignment No: 9

Objective: Study and Implementation of

- Group By & having clause
- Order by clause
- Indexing

Lab Assignment No: 10

Objective: Study & Implementation of

- Sub queries
- Views

Lab Assignment No: 11

Objective: Study & Implementation of different types of constraints.

Books recommended:

TEXT BOOKS

1. A.Silberschatz et.al - Database System Concepts, 5thEdn, Tata Mc-Graw Hill, New Delhi – 2000.

REFERENCE BOOKS

1. Date C.J. - An Introduction to Database System, Pearson Education, New Delhi, 2005.
2. R.Elmasri, Fundamentals of Database Systems, Pearson Education, New Delhi, 2005.

Program: B.Tech

Semester: Fifth

Course: Formal Language & Automata Theory

Course Code: 3PCCCS302

L	T	P	C
3	0	0	3

Course Objective:

The objectives of this course are:

- To impart foundational knowledge of finite automata and their types.
- To develop the ability to construct and analyze regular expressions and their equivalence with automata.
- To introduce formal grammars and language classifications under the Chomsky hierarchy.
- To explain the design and application of Pushdown Automata (PDA).
- To explore Turing Machines and concepts of decidability, complexity, and computational limits.

Course Outcome:

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

CO1: Design and evaluate finite automata and apply conversion techniques.

CO1: Formulate and simplify regular expressions for language recognition tasks.

CO1: Classify formal languages and construct grammars based on automata.

CO1: Develop PDAs and apply parsing techniques to context-free grammars.

CO1: Analyze Turing Machines and solve problems related to decidability and computational complexity.

Course Content:

Topics	Hours
Unit I	5
Introduction to Automata: (mathematical model of digital devices, including real computer), State Transition Graph, Finite Automaton (FA) and its types, Deterministic Finite Automaton (DFA), Non-deterministic Finite Automaton (NDFA), Complement, Union, Intersection of FA's , Conversion Strategy from NDFA to DFA , Minimization of FA, Finite Automaton with Output, Applications of FA, **Explore Paninian Grammar and ancient Indian logic systems (Nyaya) as early forms of formal language theory, emphasizing structured rule-based reasoning.**	
Unit II	7
Regular Expressions(RE): Introduction , R.E.'s and basic operations, Algebraic laws on Regular Expression, Finite and Infinite Languages, Equivalence of finite Automaton and regular expressions, Constructing NDFA from Regular Expression , Pumping Lemma for Regular Language, Closure properties of Regular Languages, Non-regular languages, Applications of Regular Expression.	
Unit III	6
Grammar: Introduction, Formal Definition of Grammar, The Chomsky Hierarchy of Grammar, Designing Regular grammar from DFA, Context Free Grammar, Closure properties of Context Free Languages, , CFG and Normal form: Chomsky Normal Form, Greibach Normal Form, Non-Context Free Language, Applications of CFGs.	
Unit IV	7
Push Down Automation (PDA): Introduction, Definition of PDA, Types of Pushdown Automata (DPDA and NPDA), Converting CFG to PDA, Derivation (Parsing), Parsing Techniques, Ambiguous and Unambiguous Grammar, Demerits of Ambiguous Grammar.	
Unit V	5
Turing Machine(TM): Single Tape TM, Variations of TM, Halting Problem, Turing Machine and Languages, Enumerable Languages, Decidable, Recognizable and Undecidable languages, Solvable and Unsolvable problems, Post Correspondence Problems(PCP), Classes of Problems', NP, NP-C and NP-Hard	

Text Books:

1. Martin John "Introduction to Languages and the Theory of Computation", 3rd Edition, TMH.

Reference Books:

1. Mishra K.L.P &Chandrasekharan N., "Theory of Computer Science", PHI.
2. Hopcroft John E. And Ullman Jeffrey D., "Introduction to Automata Theory, Languages & Computation", 3rd Edition, Narosa, 2008.
3. Lewis H. R. and Papadimitrou C. H, "Elements of the theory of Computation", PHI.

Program: B.Tech

Semester: Fifth

Course: IT Workshop (Sci Lab/MATLAB)

Course Code: 3PCCCS304

L	T	P	C
2	0	0	2

Course Objective:

The objectives of this course are:

- To introduce MATLAB basics and environment.
- To teach MATLAB operations, plotting, and data handling.
- To explore advanced MATLAB features like GUI and structures.
- To introduce Python basics including syntax and plotting.
- To develop Python skills in functions, loops, and OOP.

Course Outcome:

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

CO1: Apply MATLAB for array operations and file handling.

CO2: Use MATLAB for plotting, string, and complex data.

CO3: Implement advanced MATLAB tools and GUI elements.

CO4: Write and visualize basic programs in Python.

CO5: Solve problems using Python functions, OOP, and numerics.

Course Content:

Topics	Hours
Unit I	4
Introduction to MATLAB and Basics Part I:	
Introduction, Advantage, Disadvantage of MATLAB, MATLAB Environment, Variables and Array, Built-in Functions of MATLAB, Subarrays, Multidimensional Arrays, Data Files, **Ancient Indian texts like the *Vedic Sutras* and *Shulba Sutras* exhibit a form of stepwise logical reasoning that mirrors algorithmic thinking in modern computation (Ganesan, 2021). Recursive logic, as exemplified by *Panini's Ashtadhyayi*, demonstrates early examples of rule-based recursion.**	
Unit II	4
MATLAB Basic Part II:	
Scalar and Array Operations, Hierarchy of Operations, Introduction to Plotting, Polar Plots, Subplots, MATLAB profiler. String Functions, Complex Data, Three- Dimensional Plot	
Unit III	4
MATLAB Advanced Features:	
Sparse Arrays, Cell Arrays,Structure Arrays, I/O Functions, Object Handles, Position and Units, Graphical User Interface: Dialog Boxes, Menus, Toolbars.	
Unit IV	4
Introduction to Python Basics	
Basics, I Python, Data Types, Operators, Arrays, Plotting	
Unit V:	4
Python Programming Part 2:	
Functions and loops, object oriented programming, Numerical Formalism	

Text Books:

1. Martin John "Introduction to Languages and the Theory of Computation", 3rd Edition, TMH.

Reference Books:

1. Mishra K.L.P &Chandrasekharan N., "Theory of Computer Science", PHI.
2. Hopcroft John E. And Ullman Jeffrey D., "Introduction to Automata Theory, Languages & Computation", 3rd Edition, Narosa, 2008.
3. Lewis H. R. and Papadimitrou C. H, "Elements of the theory of Computation", PHI.

Program: B.Tech

Semester: Fifth

Course: IT Workshop Lab (Sci Lab/MATLAB)

Course Code: 3PCCCS304P

L	T	P	C
0	0	2	1

List of Experiments:

1. Practicing SCILAB environment with simple exercises to familiarize Command Window, History, Workspace, Current Directory, Figure window, Edit window, Shortcuts, Help files.
2. Data types, Constants and Variables, Character constants, operators, Assignment statements using python
3. Control Structures: For loops, While, If control structures, Switch, Break, Continue statements using python
4. Input-Output functions, Reading and Storing Data using python
5. Vectors and Matrices, commands to operate on vectors and matrices, matrixManipulations.
6. Arithmetic operations on Matrices, Relational operations on Matrices, LogicalOperations on Matrices.
7. Polynomial Evaluation, Roots of Polynomial, Arithmetic operations on Polynomials.
8. Graphics: 2D plots, Printing labels, Grid & Axes box, Text in plot, Bar and Pie chart.

Text Book

1. Bansal R.K, Goel A.K., Sharma M.K., "MATLAB and its Applications in Engineering", Pearson Education, 2012.

References

1. Amos Gilat,"MATLAB-An Introduction with Applications", Wiley India, 2009.

2. Stephen.J.Chapman,"Programming in MATLAB for Engineers", Cengage Learning,201

Program: B.Tech

Semester: Fifth

Course: Operating Systems

Course Code: 3PCCCS305

L	T	P	C
3	0	0	3

Course Objective:

The objectives of this course are:

- To introduce OS concepts, types, and case studies (UNIX, Windows).
- To explain process and thread management with scheduling techniques.
- To understand inter-process communication, synchronization, and deadlocks.
- To study memory management including paging, segmentation, and virtual memory.
- To explore file systems, I/O systems, and disk management.

Course Outcome:

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

CO1: Describe OS architecture, types, and key functionalities.

CO2: Analyze process/thread management and scheduling methods.

CO3: Apply synchronization techniques and handle deadlocks.

CO4: Evaluate memory management methods and virtual memory.

CO5: Explain file system structures, disk scheduling, and I/O management.

Course Content:

Topics	Hours
Unit I	5
Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS-Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System**, Introduce ancient Indian computational ideas from works like *Panini's grammar* as early process models, and explore time-sharing parallels in Vedic rituals as an analogy for multi-tasking.**	
Unit II	7
Processes: Definition, Process Relationship, Different states of a Process, Process Statetransitions, Process Control Block (PCB), Context switching **Thread:** Definition, Various states, Benefits of threads, Types of threads, Concept ofmultithreads, **Process Scheduling**: Foundation and Scheduling objectives, Types of Schedulers, Schedulingcriteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.	
Unit III	5
Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer\ Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc. **Deadlocks:** Definition, Necessary and sufficient conditions for Deadlock, DeadlockPrevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.	
Unit IV	7
Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction; Paging: Principle of operation – Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging. **Virtual Memory:** Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).	

Unit V	
I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/OSoftware: Goals of Interrupt handlers, Device drivers, Device independent I/O software,Secondary-Storage Structure: Disk structure, Disk scheduling algorithms	6
File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance. **Disk Management:** Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C- SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks	

Text Books:

1. Operating System Concepts Essentials, 9th Edition by AviSilberschatz, PeterGalvin, Greg Gagne, Wiley Asia Student Edition.
2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.

Reference Books:

1. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley,Irwin Publishing
2. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison-Wesley
3. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall ofIndia
4. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reillyand Associates

Program: B.Tech

Semester: Fifth

Course: Operating Systems Lab

Course Code: 3PCCCS305P

L	T	P	C
0	0	2	1

List of Programs as Assignments:

1. **Lab Assignment No: 1**
   Objective: To Understand and Implement Directory Structure
   Q1. WAP to create a File directory system.

2. **Lab Assignment No: 2**
   Objective: To understand and Implement Scheduling Processes
   Q1. WAP to schedule various processes

3. **Lab Assignment No: 3**
   Objective: To Understand and Implement FCFS
   Q1. WAP to implement FCFS CPU Scheduling

4. **Lab Assignment No: 4**
   Objective: To Understand and Implement SJF
   Q1. WAP to implement SJF CPU scheduling.

5. **Lab Assignment No: 5**
   Objective: To Understand and Implement SRTF
   Q1.WAP to implement SRTF CPU scheduling.

6. **Lab Assignment No: 6**
   Objective: To Understand and Implement Scheduling algorithms
   Q1. WAP to implement Round Robin Scheduling

7. **Lab Assignment No: 7**
   Objective: To Understand and Implement Scheduling algorithms

Q1 WAP to implement SRTF scheduling.

8. Lab Assignment No: 8

Objective: To Understand and Implement context switching

Q1. WAP to implement Round Robin Scheduling with context switching.

9. Lab Assignment No: 9

Objective: To Understand and Implement context switching.

Q1.WAP to implement SRTF with context switching.

10. Lab Assignment No: 10

Objective: To Understand and Implement Page Replacement Techniques

Q1. WAP to implement FCFS page replacement algorithm.

Q2. WAP to implement optimal page replacement algorithm.

Program: B.Tech

Semester: Fifth

Course: Character Building & Holistic Development of Personality- III (Universal Human Values and Ethics)

Course Code: 3VAC301

L	T	P	C
2	0	0	2

Course Learning Objective:

The objectives of this course are:

- To familiarize students with Indian cultural values.
- To inspire students to preserve and protect values and ethics.
- To build moral, ethical, energetic individual dedicated towards the service of humanity.
- To focus on holistic development of an individual.

Course Outcome:

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

CO1: Students will understand the importance of Indian cultural values.

CO2: Students will learn to adapt, protect, and preserve values and ethics.

CO3: Students will become responsible citizens committed to serving humanity.

CO4: Students will develop their personality holistically and in a balanced manner.

Course Content:

Topics	Hours
Unit I	4
Personality Development: Meaning, Concept, Constituent elements of personality and Means/Ways of Personality Development. Panchakosha: General Introduction, Meaning, Objectives, Characteristics and Significance. Benefits of Panchakosha, development and deficiencies due to underdevelopment of Panchkosha, **Study of *Panchakosha* and *Vasudhaiva Kutumbakam* from ancient Indian texts to cultivate holistic personality, emotional balance, and ethical living rooted in Indian culture.**	
Unit II	4
Mental Emotional Development: Values and Individual: Non-Possession, Non-Stealing, Self-Restrain, Enthusiasm, Dutifulnes, Reticence, Silence, Self-study, Considerateness and Self-respect. Values and Family: Respectful Salutation, Obedience, Contentment, Patience, hospitality, Parent Service, Rectitude, Good Behaviour, Family feeling and worship.	
Unit III	8
Indian Values : Values and Society: Discipline, Social Responsibility and Duties of Citizens, Altruism/ Charity, Keeping good company, Gratefulness, Fraternity/ Friendship, Courtesy, Tactfulness, Soft Spoken and Feeling for the Oppressed. Values and Constitution: Dignity of an Individual, Fundamental Duties, Fundamental rights, Directive Principles of State Policies, Social Equality, Democracy, Justice, Freedom, Sarva-Pantha Samman and Scientific Approach.	
Unit IV	8
Practice of Values: Values and Indian Culture: Integrity of the nation, Glory of the Past, Swadeshi, Nation Building, Patriotism, Mother Tongue, National Unity, Public Welfare, Equality and Spirituality. Values and Vision of the World: Humanity, Integrity, Human rights, The Highest or Most Sublime Good, Vasudhaiva Kutumbakam, Tolerance, Peaceful Coexistence, World-Welfare, Environmental Protection, Swavalamban/Self-reliance	

Suggested Reading:

1. My Idea of Education, Swami Vivekanand, Advaita Ashram, Kolkata
2. Personality Development, Swami Vivekananda, Advaita Ashram, Kolkata.
3. The Man India Missed the Most; Subhash Chandra Bose, huvan Lall, Notion Press, Chennai

JHARKHAND Rai University
RANCHI

SPECIALIZATION IN ARTIFICIAL INTELLIGENCE

TRACK ELECTIVE - I

Program: B.Tech

Semester: Fifth

Course: Introduction to Python Programming

Course Code: 3TECCS301

L	T	P	C
3	0	0	3

Course Objective:

The objectives of this course are:

- To introduce Python programming fundamentals including variables, operators, and data types.
- To develop understanding of program control structures like conditionals and loops.
- To build skills in handling complex data types, functions, and code modularization.
- To train students in file handling, database operations, and exception management in Python.

Course Outcome:

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

CO1: Understand and apply basic Python syntax, variables, and data types in simple programs.

CO2: Write Python programs using conditionals, loops, and control flow statements effectively.

CO3: Manipulate complex data types like strings, lists, tuples, and dictionaries using built-in methods.

CO4: Perform file and database operations with exception handling using Python.

Course Content:

Topics	Hours
Unit I	6
Introduction to Python: Python variables, Python basic Operators, Understanding python blocks. Python Data Types, Declaring and using Numeric data types: int, float etc, **Application of *Panini's grammar rules* as inspiration for syntactic structures and *ancient Indian logic systems (Nyaya)* in programming control flow and decision-making.**	
Unit II	8
Python Program Flow Control Conditional blocks: if, else and else if, Simple for loops in python, For loop using ranges, string, list and dictionaries. Use of while loops in python, Loop manipulation using pass, continue, break and else. Programming using Python conditional and loop blocks.	
Unit III	9
Python Complex data types: Using string data type and string operations, Defining list and list slicing, Use of Tuple data type. String, List and Dictionary, Manipulations Building blocks of python programs, string manipulation methods, List manipulation. Dictionary manipulation, Programming using string, list and dictionary in-built functions. Python Functions, Organizing python codes using functions.	
Unit IV	7
Python File Operations: Reading files, Writing files in python, Understanding read functions, read(), readline(), readlines(). Understanding write functions, write() and writelines() Manipulating file pointer using seek Programming, using file operations. Database Programming: Connecting to a database, Creating Tables,INSERT, UPDATE, DELETE and READ operations, Transaction Control,Disconnecting from a database, Exception Handling in Databases.	

Suggested readings:

1. Python Crash Course: A Hands-On, Project-Based Introduction to Programming (2ndEdition)
2. Head-First Python: A Brain-Friendly Guide (2nd Edition)
3. Learn Python the Hard Way: 3rd Edition
4. Python Programming: An Introduction to Computer Science (3rd Edition)

Program: B.Tech

Semester: Fifth

Course: Introduction to Python Programming Lab

Course Code: 3TECCS301P

L	T	P	C
0	0	2	1

Course Content:

List of experiments:

1. Write a program to demonstrate different number datatypes in python.
2. Write a program to perform different arithmetic operations on numbers in python.
3. Write a program to create, concatenate and print a string and accessing substring from agiven string.
4. Write a python script to print the current date
5. Write a python program to create, append and remove lists in python.
6. Write a program to demonstrate working with tuples in python.
7. Write a program to demonstrate working with dictionaries in python.
8. Write a python program to find largest of three numbers
9. Write a python program to convert temperature to and from Celsius to Fahrenheit.
10. Write a python program to print prim numbers less than 20.
11. Write a python program to find factorial of a number using recursion.
12. Write a python program to define a module and import a specific function in that moduleto another program.
13. Write a Python class to implement pow (x, n).
14. Write a Python class to reverse a string word by word.

Program:B.Tech

Semester: Fifth

Course: Pattern Recognition

Course Code: 3TECCS307

L	T	P	C
4	0	0	4

Course Objective:

The objectives of this course are:

- To build a foundation in probability, random processes, and linear algebra for pattern recognition.
- To introduce Bayes Decision Theory and probabilistic classification methods.
- To explore clustering, HMMs, and other unsupervised learning techniques.
- To study nonparametric methods and dimensionality reduction techniques.
- To understand classification methods like perceptrons, SVMs, and decision trees.

Course Outcome:

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

CO1: Apply probability and linear algebra in pattern recognition.

CO2: Use Bayes theory and parameter estimation for classification.

CO3: Implement clustering and HMMs for data analysis.

CO4: Apply nonparametric and dimensionality reduction methods.

CO5: Design classifiers using SVMs, decision trees, and linear models.

Course Content:

Topics	Hours
Unit I	6
Basics of Probability, Random Processes and Linear Algebra: Probability: independence of events, conditional and joint probability, Bayes' theorem; Random Processes: Stationary and nonstationary processes, Expectation, Autocorrelation, Cross-Correlation, spectra; Linear Algebra: Inner product, outer product, inverses, eigen values, eigen vectors; Bayes Decision Theory, **Inspiration from *Chanakya's decision models* and *Vedic probability concepts* in uncertain reasoning, along with *Indian logic systems (Nyaya)* to enhance understanding of inference, classification, and pattern recognition.**	
Unit II	7
Bayes Decision Theory: Minimum-error-rate classification, Classifiers, Discriminant functions, Decision surfaces, Normal density and discriminant functions, discrete features • **Parameter Estimation Methods**: Maximum- Likelihood estimation: Gaussian case; Maximum a Posteriori estimation; Bayesian estimation: Gaussian case.	
Unit III	5
Unsupervised learning and clustering: Criterion functions for clustering; Algorithms for clustering: K-Means, Hierarchical and other methods; Cluster validation; Gaussian mixture models; Expectation-Maximization method for parameter estimation; Maximum entropy estimation **Sequential Pattern Recognition:** Hidden Markov Models (HMMs); Discrete HMMs; Continuous HMMs	
Unit IV	6
Nonparametric techniques for density estimation: Parzen-window method; K- Nearest Neighbour method **Dimensionality reduction:** Fisher discriminant analysis; Principal component analysis; Factor Analysis	
Unit V	6
Linear discriminant functions: Gradient descent procedures; Perceptron; Support vector machines **Non-metric methods for pattern classification:** Non-numeric data or nominal data; Decision trees: CART	

Textbooks and Suggested Readings:

1. R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001
2. S.Theodoridis and K.Koutroumbas, Pattern Recognition, 4th Ed., Academic Press,2009
3. C.M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006

Program: B.Tech

Semester: Fifth

Course: Intelligent Systems

Course Code: 3TECCS308

L	T	P	C
4	0	0	4

Course Objective:

The objectives of this course are:

- To introduce the fundamental concepts of neural networks, including perceptrons and their limitations.
- To explore multilayer neural networks and training algorithms such as backpropagation and Boltzmann training.
- To understand the structure and applications of resonant networks in solving real-world problems.
- To develop foundational knowledge of fuzzy set theory and fuzzy logic operations.
- To analyze fuzzy logic systems and their integration with neural networks for intelligent system design.

Course Outcome:

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

CO1: Describe basic neural network models and learning rules.

CO2: Train multilayer networks using various algorithms and evaluate their performance.

CO3: Apply resonant networks to pattern recognition and optimization tasks.

CO4: Perform fuzzy set operations and analyze fuzzy relations.

CO5: Design fuzzy systems and integrate them with neural networks.

Course Content:

Topics	Hours
Unit I	6
INTRODUCTION AND BASIC CONCEPTS	
Introduction- Humans and Computers, The structure of the brain, Learning in machines and the differences. The basic neuron- Introduction, Modeling the single neuron, learning in simple neurons, The perception: a vectorial perspective, The perception learning rule, Proof of perceptron, Limitations of perceptrons, **Inspiration from *Patanjali Yoga Sutras* and *Indian philosophical systems* like *Samkhya* to explain the layered functioning of consciousness, decision-making, and fuzzy logic in human cognition.**	
Unit II	7
MULTILAYER NETWORKS	
The multilayer perceptron: Introduction, Altering the perception model, The new model, the new learning rule, Multilayer perception algorithm, XOR problem. Multilayer feed forward networks, error back propagation training algorithm, Problems with back propagation, Boltzman training, Combined back propagation, Cauchy training.	
Unit III	5
RESONANT NETWORKS AND APPLICATIONS	
Hop-field networks, Recurrent and bi-directional associative memories, Problems on BAM, Counter propagation network, Problems on counter propagation network, Artificial Resonance Theory (ART), Application of neural network: Hand written digit recognition, Application of neural network: character recognition, Traveling sales man problem, a neuro-controller.	
Unit IV	6
FUZZY SET THEORY	
Introduction to fuzzy set theory, Fuzzy set vs Crisp set, Problems on fuzzy set and crisp sets, Properties of fuzzy sets, Operations on fuzzy set, Fuzzy compliments, Fuzzy intersection, Fuzzy union, Fuzzy relations.	
Unit V	6
FUZZY LOGIC AND SYSTEMS	
Fuzzy Logic: Classical logic, multi valued logic, Fuzzy propositions, Fuzzy quantifiers, Linguistic hedges and their inferences. Fuzzy systems: fuzzy controllers, Fuzzy systems and neural networks, Fuzzy automata, Fuzzy dynamic system.	

Textbooks and Suggested Readings:

1. G.J.Klir& Bo Yuan, “Fuzzy Sets and Fuzzy Logic Theory and Applications”, Prentice Hallof India, 2009.
2. Timothy S.Ross, “Fuzzy Logic with engineering applications”, Weily India Pvt. Ltd.,2011.
3. Kosko B, “Neural Networks and Fuzzy Systems: A dynamical system approach tomachine intelligence”, Prentice Hall of India, 2009.
4. R Beale & T Jackson, “Neural Computing, An Introduction”, AdamHilger, 1990.
5. Rao V.B and Rao H.V., “C++, Neural Networks and Fuzzy Logic”, BPB Publications,2003.
6. Simon Kendal, Malcolm Creen, “An Introduction to KnowledgeEngineering”, Springer-Verlag Limited, 2007.

JHARKHAND Rai University RANCHI

Semester VI

SEMESTER VI														
S.No.		**BROAD CATEGORY**	**CATEGORY**	**CODE**	**COURSE TITLE**	**Periods**			**Evaluation Scheme**				**SubjectTotal**	**Credit**
						L	**T**	**P**	**Assignment**	**TA**	**Total**	**ESE**		
1	5.5	Professional Core Course	Core Courses (CC)-Major	3PCCCS306	Compiler Design	3	0	0	20	10	30	70	100	3
2		Professional Core Course	Core Courses (CC)-Major	3PCCCS307	Computer Networks	3	0	0	20	10	30	70	100	3
3		Professional Core Course	Core Courses (CC)-Major	3PCCCS308	Fundamentals of Software Engineering	3	0	0	20	10	30	70	100	3
4		Track Elective	Core Courses (CC)-Major		Track Elective II	3	0	0	20	10	30	70	100	3
5		Track Elective	Core Courses (CC)-Major		Track Elective III	3	0	0	20	10	30	70	100	3
6		Open ElectiveCourse	Core Course (CC)-Minor		Open Elective I / MOOCs I	3	0	0	20	10	30	70	100	3
PRACTICAL /SESSIONAL														
1	5.5	Professional CoreCourse	Core Courses (CC)-Major	3PCCCS306P	Compiler DesignLab	0	0	2			30	20	50	1
2		Professional CoreCourse	Core Courses (CC)-Major	3PCCCS307P	Computer Networks Lab	0	0	2			30	20	50	1
3		Professional CoreCourse	Core Courses (CC)-Major	3PCCCS308P	Fundamentals of Software Engineering Lab	0	0	2			30	20	50	1
4		Project	Project	3PROJCS301	Project-I	0	0	6	20	10	50	50	100	3
											TOTAL		**800**	**24**

Program: B.Tech

Semester: Sixth

Course: Compiler Design

Course Code: 3PCCCS306

L	T	P	C
3	0	0	3

Course Objective:

The objectives of this course are:

- To introduce the structure and functions of compilers and perform lexical analysis using tools like Lex.
- To explain parsing techniques and analyze grammars using top-down and bottom-up approaches.
- To familiarize students with syntax-directed definitions and translation schemes.
- To teach intermediate code generation using syntax trees, three-address code, and control flow.
- To explain target code generation and apply machine-independent optimization techniques.

Course Outcome:

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

CO1: Understand the structure of compilers and perform lexical analysis using token specification and recognition techniques.

CO2: Apply syntax analysis methods using various parsing techniques, resolving ambiguities and handling parsing errors.

CO3: Construct and evaluate syntax-directed definitions and implement translation schemes.

CO4: Generate intermediate code including three-address code, manage control flow, and perform back patching.

CO5: Design and optimize target code using flow graphs, basic blocks, and perform machine-independent optimizations.

Course Content:

Topics	Hours
Unit I	6
Introduction to Compilers and its Cousins, Structure of a Compiler, Science of building Compiler and its Application, Lexical Analyzer, Input Buffering, Specification and Recognition of Tokens, Introduction to Lex, **Ancient Indian grammarian *Panini's Ashtadhyayi* as an early example of formal language rules, showcasing structured syntax and grammar applicable in modern compiler theory.**	
Unit II	8
Introduction to Syntax Analysis, Elimination of Ambiguity, Left Recursion and Left Factoring, Recursive and Non-Recursive Top-Down Parsers, Bottom-up Parsers: Shift Reduce Parser techniques and conflicts, all variants of LR Parsers, Handling Ambiguous grammar in Bottom-Up Parsing, Error handling while parsing, The Parser generator YAAC.	
Unit III	5
Syntax-Directed Definition(SDD), Evaluation Order of SDD‟s and its application, Syntax Directed Translation Schemes and their Implementation.	
Unit IV	6
Intermediate code Generation: Variants of Syntax Tree, Three Address Code, Translation of Expressions, Control flow, Back Patching , Run Time Environment: Storage Organization.	
Unit V	**5**
Code Generation: Issues in its Design, Target Language, Addresses in Target Code, Basic Blocks and Flow Graphs, Optimization of Basic Blocks Machine Independent Optimization: Sources of Optimization, Data Flow analysis.	

Suggested books:

1. Aho A. V., Lam M. S., Sethi R., Ullman J. D., Compilers, Principles, Techniques, and Tool, 2nd Edition, Pearson Education Asia.

Suggested reference books

1. Fischer C. N., LeBlanc R. J., Crafting a Compiler with C, Pearson Education Asia.
2. Louden K. C., Compiler Construction, Principles and Practice, Thomson, Brooks/Cole.

Program: B.Tech

Semester: Sixth

Course: Compiler Design Lab

Course Code: 3PCCCS306P

L	T	P	C
0	0	2	1

List of Programs as Assignments:

Lab Assignment No: 1

Objective: To Understand the concept of tokens.

Q1. C program to count white spaces, numbers, words in a file.

Lab Assignment No: 2

Objective: To Understand the process of identification of tokens.

Q1. C program to design Finite automata to identify different tokens (identifiers, constants, Operators, etc.).

Lab Assignment No: 3

Objective: To have a brief Understanding to lex programming.

Q1. Count number of a‟s in given string.

Q2. Identify different patterns like aa, ab, not containing a, etc. in given string .

Lab Assignment No: 4

Objective: To Understand lex programming tool.

Q1. Lex program to Identify all tokens of C programs.

Lab Assignment No: 5

Objective: To Understand and Implement structure of any programming language. Q1.Design and Code individual programming code with all possible tokens in programming language.

Lab Assignment No: 6

Objective: To Understand lex programming tool in depth.

Q1. Starting and ending with „a‟.

Q2. # a‟s divisible by 2 or b‟s divisble by 3.

Q3. 4th Symbol „a‟ from RHS.

Q4. Output code after removing white spaces and comment.

Lab Assignment No: 7

Objective: To Understand and Implement Parser using yacc. Q1.

Build parsers using yacc for

L(G)={a

nb

n

| n >= 1} over {a,b}

Lab Assignment No: 8

Objective: To Understand and Implement parser for different grammars.

Q1.Build Parser using yacc for L(G) where rule set of G is { S ->aSb, S->bSa, S->c} over {a,b,c}.

Lab Assignment No: 9

Objective: To Understand and Implement parser coding.

Q1. Build parser using yacc to convert the infix expression to postfix expression.

Lab Assignment No: 10

Objective: To Understand and Implement parser coding.

Q1. Build a calculator in yacc which takes expression in postfix notation.

Q2. Build parsers using yacc to convert the prefix expression into the postfix expression.

Lab Assignment No: 11

Objective: To Understand and Implement parser for validation and operations.

Q1. Build parsers using yacc to validate the C statements. E.g int a,b,c;(valid) Q2.

Build calculator in yacc.

Books recommended:

Text books

lex&yacc (2nd ed.) :O'Reilly & Associates, Inc. Sebastopol, CA, USA ©1992 .

Reference books

Lex &Yacc:O'Reilly & Associates, Inc. Sebastopol, CA, USA ©1992.

Program: B.Tech

Semester: Sixth

Course: Computer Networks

Course Code: 3PCCCS307

L	T	P	C
3	0	0	3

Course Objective:

The objectives of this course are:

- To introduce the fundamentals of data communication, networking components, and communication protocols.
- To explain the working of data link layer functions including error detection, correction, and media access control techniques.
- To impart knowledge on network layer addressing, routing, and switching mechanisms.
- To explore transport layer protocols and congestion control techniques.
- To understand application layer services, security concepts, and network management protocols.

Course Outcome:

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

CO1: Describe various network types, topologies, communication models, and bandwidth utilization techniques.

CO2: Analyze error control methods and media access protocols used in data link layer.

CO3: Apply network layer protocols for logical addressing, routing, and IP configuration.

CO4: Evaluate transport layer functionalities including TCP/UDP operations and congestion control strategies.

CO5: Identify and explain application layer protocols and basic network security mechanisms.

Course Content:

Topics	Hours
Unit I	**6**
Data communication Components: Representation of data and its flow Networks, Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum, **Ancient Indian systems like "Paatal Yantra" and optical signal towers illustrate early concepts of communication and networking.**	
Unit II	**8**
Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA,CSMA/CD,CDMA/CA	
Unit III	**5**
Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP,RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.	
Unit IV	**6**
Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.	
Unit V	**5**
Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography	

Suggested books:

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw- Hill.
2. Data and Computer Communication, 8th Edition, William Stallings, PearsonPrentice Hall India.

Suggested reference books

1. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.
2. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.
3. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America.

Program:

B.Tech

Semester: Sixth

Course: Computer Networks Lab

Course Code: 3PCCCS307P

L	T	P	C
0	0	2	1

List of Programs as Assignments:

1. **Lab Assignment No: 1**

   Q1. To familiarize with the Lab Network Topology, Locating different interfaces, routers and switches. Studying different pools of IP addresses.

   Q2. Implement the data link layer framing methods such as character, character stuffing, and bit stuffing.

   Q3. To learn and observe the usage of different networking commands e.g. PING, TRACEROUTE. Learning remote login using telnet session. Measuring typical average delays between different locations of the network.

2. **Lab Assignment No: 2**

   Q1. What is the IP of the machine you are using? Compare it with the IP of your neighbors. Are the IPs of your neighbors same? Why or Why not?

   Q2. Ping" is a tool used to determine if a server is responding and to estimate the round trip time of a message sent to that server. Use the ping command for the following URLs and record the success or failure statistics along with the average round trip time.

   a) google.com

   b) facebook.com

   c) jru.edu.in

   Q3. Trace the route that is taken when you try to access:

   a) google.com

   b) facebook.com

   c) jru.edu.in

   Q4. Network Commands on Linux / Unix

3. Lab Assignment No: 3

Q1. Implement on a data set of characters the three CRC polynomials – CRC 12, CRC 16 and CRC 32.

Q2. Implementation of Sub-netting and Super-netting.

Q3. To study different types of transmission media, various topologies, and configure modem of computer HUB and Switches.

4. Lab Assignment No: 4

Q1. Write a C/C++ program to determine if the IP address is in Class A, B, C, D, or E.

Q2. Write a C/C++ program to determine if the IP address is in Class A, B, or C.

Q3. Write a C/C++ program to translate dotted decimal IP address into 32 bit address.

Q4. To implement a routing protocol and check its connectivity in a variable length subnet masked network

Q5. Write a C/C++ program to perform bit stuffing and de-stuffing.

5. Lab Assignment No: 5

Q1. Implement Dijkstra,,s algorithm to compute the Shortest path through a graph.

Q2. Take an example subnet graph with weights indicating delay between nodes.

Now obtain Routing table art each node using distance vector routing algorithm

Q3. Take an example subnet of hosts. Obtain broadcast tree for it.

6. Lab Assignment No: 6

Q1. Build implementations of the Internet protocols

Q2. Implementation of Stop and Wait Protocol and Sliding Window Protocol.

Q3. Write a code simulating ARP /RARP protocols.

7. Lab Assignment No: 7

Q1. Create a socket for HTTP for web page upload and download

Q2. Write a code simulating PING and TRACEROUTE commands.

Books recommended:

Suggested books:

1. William Stallings, Data and Computer Communication, Prentice Hall of India.
2. Behrouz A. Forouzan, Data Communication and Networking, McGraw-Hill.
3. Andrew S. Tanenbaum, Computer Networks, Prentice Hall.

Suggested reference books

1. W. Richard Stevens, TCP/IP Illustrated, Volume 1, Addison-Wesley.
2. Douglas Comer, Internetworking with TCP/IP, Volume 1, Prentice Hall of India.

Program: B.Tech

Semester: Sixth

Course: Fundamentals of Software Engineering

Course Code: 3PCCCS308

L	T	P	C
3	0	0	3

Course Objective:

The objectives of this course are:

- To introduce core software engineering concepts, including process models and project management.
- To understand software requirements, IEEE SRS standards, and the requirement engineering process.
- To learn software design principles and object-oriented modeling using UML.
- To explain verification, validation, and testing techniques for software quality.
- To develop skills in project estimation, software metrics, quality assurance, and maintenance.

Course Outcome:

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

CO1: Apply software process models and perform project planning and scheduling.

CO2: Prepare and evaluate SRS documents using IEEE standards and conduct requirement engineering.

CO3: Design object-oriented software systems using UML diagrams and design principles.

CO4: Apply verification, validation, and testing techniques to ensure software quality.

CO5: Use estimation models, apply metrics, and manage software quality and maintenance processes.

Course Content:

Topics	Hours
Unit I	6
Introduction: Some Definitions, FAQs about software engineering, the evolving role of software, Software process models, Waterfall model, the prototyping model, spiral model, RAD and Incremental model, Management activities, Project planning and Project Scheduling, **Ancient Indian project management practices seen in architectural marvels like Nalanda and stepwells reflect early principles of systematic planning, modular design, and quality assurance.**	
Unit II	7
Software Requirements: Functional and non-functional requirements, User requirements, System requirements, the software requirements document. IEEE standard of SRS, Quality of good SRS. **Requirement Engineering Process**: Feasibility study, Requirements elicitation and analysis, Requirements validation, Requirement management.	
Unit III	5
Design Engineering: Design Process and Design Quality, Design Concepts, Design Models, Object oriented Design, UML: Class diagram, Sequence diagram, Collaboration diagram.	
Unit IV	6
Verification and Validation: Verification and Validation Planning, S/W inspection, static analysis. **Software Testing:** Testing functions, Test care design, White Box testing, Black box testing, Unit testing, Integration Testing, System testing, Reliability.	
Unit V	6
Process metrics, Software Measurement, Software Project Estimation, Decomposition Techniques, Empirical Estimation Models, Quality assurance and standards, Quality planning, Quality control, S/W Maintenance in detail.	

Suggested Text Book:

1. Sommerville, Software Engineering, 7th Edition, Pearson Education Publication.

Suggested Reference Books:

1. Pressman R. S.,Software Engineering: A Practiioners Approach, 5th Edition., TMA,New Delhi.
2. Mall Rajib, Fundamental of Software Engineering, 4th Edition, PHI Learning Private
3. Limited.
4. Peters J. F. &Pedrycz W., Software Engineering, John Wiley & Sons, Inc. 2000.
5. Behforooz A. & Hudson F.J., Software Engineering Fundamentals, Oxford Univ.Press, New York, 2000

Program: B.Tech

Semester: Sixth

Course: Fundamentals of Software Engineering Lab

Course Code: 3PCCCS308P

L	T	P	C
0	0	2	1

List of Programs as Assignments:

1. **Lab Assignment No: 1**

   Objective: To Understand and Implement Identification of Requirements from Problem Statements

   Q1. To consider the problem statement for a project to be developed and list out the ambiguities, inconsistencies and incompleteness of the problem statement.

   Q2. To identify different functionaries to be obtained from a system and characteristics that a system should have, but not possessed by the system itself

2. **Lab Assignment No: 2**

   Objective: To Understand and Implement Estimation of Project Metrics

   Q1. To estimate the minimum size of the team one would require to develop a project through application of intermediate COCOMO.

   Q2. To use Halstead's metrics to estimate the effort required to recreate a program in JAVA from C.

3. **Lab Assignment No: 3**

   Objective: To Understand and Implement Modeling UML Use Case Diagrams and Capturing UseCase Scenarios

   Q1. To draw a use case diagram for the given case study.

   Q2. To identify the primary and secondary actors for the system and generalization of use cases and «include» stereotypes to prevent redundancy in the coding phase.

4. **Lab Assignment No: 4**

   Objective: To Understand and Implement E-R Modeling from the Problem Statements

   Q1. To identify the possible entity sets, their attributes, and relationships for the given case study.

   Q2. To draw an ER diagram for the given case study.

5. **Lab** **Assignment No: 5**

Objective: To Understand and Implement Identification of Domain Classes from the Problem Statements

Q1. To identify potential classes and their attributes for the given case study.

Q2. To utilize expert knowledge on the subject matter to identify other relevant classes.

6. **Lab Assignment No: 6**

Objective: To Understand and Implement Identification of Components from the Problem Statements

Q1. To identify potential components for the given case study.

Q2. To draw component diagram for the given case study

7. **Lab Assignment No: 7**

Objective: To Understand and Implement State Chart and Activity Modeling

Q1. To draw a state chart diagram to graphically represent the given case study.

Q2. To draw an activity diagram to graphically represent the workflow of the given case study.

8. **Lab Assignment No: 8**

Objective: To understand and Implement Modeling UML Class Diagrams and Sequence diagrams

Q1. To draw class diagram for the given case study.

Q2. To draw sequence diagram for the given case study.

9. **Lab Assignment No: 9**

Objective: To Understand and Implement Modeling Data Flow Diagrams

Q1. To draw data flow diagram (Level 0, 1 and 2) for the given case study.

10. **Lab Assignment No: 10**

Objective: To Understand and Implement Estimation of Test Coverage Metrics and Structural Complexity

Q1. To identify the basic blocks for a given program

Q2. To draw a CFG using the basic blocks

Q3. To determine McCabe's complexity from a CFG.

11. **Lab Assignment No: 11**

Objective: To Understand and Implement Designing Test Suites

Q1. To design a test suite for the given case study.

Q2. To verify implementation of functional requirements by writing test cases.

Q3. To analyze results of testing to ascertain the current state of the project.

12. **Lab Assignment No: 12**

Objective: To Understand and Implement Forward and Reverse Engineering

Q1. To obtain programs from UML diagrams.

Q2. To obtain UML diagrams from programs.

Program: B.Tech

Semester: Sixth

Course: Project-I

Course Code: 3PROJCS301

L	T	P	C
0	0	6	3

The knowledge gained in previous courses are to be applied to a practical problem in various disciplines Demonstrate their ability to work independently and collaboratively.

JHARKHAND Rai University
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SPECIALIZATION IN ARTIFICIAL INTELLIGENCE

TRACK ELECTIVE – II

TRACK ELECTIVE – III

Program: B.Tech

Semester: Sixth

Course: Distributed Database Management System

Course Code: 3TECCS311

L	T	P	C
3	0	0	3

Course Objective:

The objectives of this course are:

- To introduce the concepts, architecture, and design issues of Distributed Database Management Systems (DDBMS)**.**
- To explain query processing and optimization techniques in a distributed environment.
- To provide insights into transaction management and concurrency control mechanisms in DDBMS.
- To develop understanding of reliability, fault tolerance, and parallel database **architectures**.
- To familiarize students with object-oriented and distributed object databases and their design models.

Course Outcome:

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

CO1: Understand the fundamentals, architecture, and design strategies of distributed databases.

CO2: Analyze and implement query decomposition and optimization methods in distributed systems.

CO3: Apply transaction management concepts and concurrency control techniques in distributed databases.

CO4: Evaluate the reliability and fault-tolerance aspects of DDBMS and parallel database operations.

CO5: Compare object-oriented and object-relational database systems and design distributed object databases.

Course Content:

Topics	Hours
Unit I	6
Introduction; Distributed Data Processing, Distributed Database System, Promises of DDBSs, Problem areas. **Distributed DBMS Architecture:** Architectural Models for Distributed DBMS, DDMBS Architecture. **Distributed Database Design:** Alternative Design Strategies, Distribution Design issues, Fragmentation, Allocation, **The concept of distributed knowledge systems in ancient India, like the decentralized preservation of texts across gurukuls and libraries such as Nalanda and Takshashila, echoes modern DDBMS principles of fragmentation, replication, and distributed access.**	
Unit II	6
Query processing and decomposition: Query processing objectives, characterization of query processors, layers of query processing, query decomposition, localization of distributed data. **Distributed query Optimization:** Query optimization, centralized query optimization, distributed query optimization algorithms.	
Unit III	6
Transaction Management: Definition, properties of transaction, types of transactions, distributed concurrency control: serializability, concurrency control mechanisms & algorithms, time - stamped & optimistic concurrency control Algorithms, deadlock Management.	
Unit IV	6
Distributed DBMS Reliability: Reliability concepts and measures, fault-tolerance in distributed systems, failures in Distributed DBMS, local & distributed reliability protocols, site failures and network partitioning. **Parallel Database Systems:** Parallel database system architectures, parallel data placement, parallel query processing, load balancing, database clusters.	
Unit V	6
Distributed object Database Management Systems: Fundamental object concepts and models, object distributed design, architectural issues, object management, distributed object storage, object query Processing. **Object Oriented Data Model:** Inheritance, object identity, persistent programming languages, persistence of objects, comparison OODBMS and ORDBMS	

Suggested books:

1. M. Tamer OZSU and Patuck Valduriez: Principles of Distributed Database Systems, Pearson Edn. Asia, 2001.
2. Stefano Ceri and Giuseppe Pelagatti: Distributed Databases, McGraw Hill.

Suggested reference books

1. Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom: "Database Systems: The Complete Book", Second Edition, Pearson International Edition

Program: B.Tech

Semester: Sixth

Course: Distributed Database Management System Lab

Course Code: 3TECCS311P

L	T	P	C
0	0	2	1

List of Experiments:

1. A) Introduction of Database management systems, Oracle concepts and Create a table.
   B) How to insert data in a table using insert and display the records in a table.
2. A) Update or Delete records of a table and modifying structure of a table using Alter and Drop command.
   B) Study of character functions for manipulation of data items.
3. To perform join operation between various tables.
4. Applying constraint using two tables.
5. How to retrieve data from different tables using sub queries and correlated queries.
6. Create two databases either on single DBMS and Design Database to fragment and share the fragments from both database and write single query for creating view.
7. Understanding of Database Objects: synonym, sequence, index and view.
8. To study the concepts of Normalization.
9. Case study on noSQL.
10. Case study on hadoop.

Program: B.Tech

Semester: Sixth

Course: Machine Learning

Course Code: 3TECCS312

L	T	P	C
3	0	0	3

Course Objective:

The objectives of this course are:

- To introduce the fundamentals of machine learning and its mathematical foundations.
- To develop understanding of supervised learning techniques and evaluation methods.
- To explore neural networks and training methods including backpropagation.
- To understand unsupervised and semi-supervised learning approaches.
- To study ensemble learning methods like bagging, boosting, and active learning.

Course Outcome:

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

CO1: Describe the fundamentals of machine learning, including linear regression and essential concepts in linear algebra and statistics.

CO2: Apply supervised learning techniques such as decision trees, logistic regression, and SVMs, and evaluate model performance using appropriate metrics.

CO3: Construct and train neural networks using backpropagation, and analyze issues such as overfitting and learning network structures.

CO4: Implement unsupervised and semi-supervised learning algorithms, including k-means, hierarchical clustering, and EM-based approaches.

CO5: Apply ensemble methods such as bagging, boosting, and active learning to enhance model accuracy and robustness.

Course Content:

Topics	Hours
Unit I	6
Introduction to Machine learning Machine Learning – what and why? Basics of Linear Algebra and Statistics, Overview of target function representations; Linear Regression, **Ancient Indian systems like Ayurveda and astrology reflect early use of pattern recognition and classification, aligning with modern machine learning principles.**	
Unit II	7
Supervised Learning Basics of Feature Selection and Evaluation, Decision Tree, Overfitting and Pruning, Logistic regression, Support Vector Machine and Kernel; Noise, bias- variance trade-off, under-fitting and over-fitting concepts	
Unit III	6
Neural Networks Perceptions: representational limitation and gradient descent training. Multilayer networks and back propagation. Hidden layers and constructing intermediate, distributed representations. Overfitting, learning network structure, recurrent networks.	
Unit IV	5
Unsupervised and Semi Supervised Learning Learning from unclassified data. Clustering. Hierarchical Agglomerative Clustering. kmeans partitioned clustering. Expectation maximization (EM) for soft clustering. Semi supervised learning with EM using labelled and unlabeled data.	
Unit V	6
Ensemble Committees of multiple hypotheses, bagging, boosting, active learning with ensembles,	

Suggested Text Books:

1. Mitchell Tom, Machine Learning, Latest Edition, Mc-Graw Hill.

Suggested Reference Books:

1. Shalev-Shwartz Shai and Ben-David Shai, Understanding Machine Learning, Cambridge University Press. 2017.
2. Bishop Christopher, Pattern Recognition and Machine Learning, Springer, 2006.

Program: B.Tech

Semester: Sixth

Course: Web Technology

Course Code: 3TECCS313

L	T	P	C
3	0	0	3

Course Objective:

The objectives of this course are:

- To introduce HTML, CSS, and JavaScript for building basic static and dynamic web pages.
- To provide understanding of JDBC concepts for database connectivity and operations in Java applications.
- To explore web server configuration and Servlet technology for developing server-side applications.
- To teach JavaServer Pages (JSP) for dynamic content generation and web application development using MVC architecture.
- To familiarize students with PHP and MySQL for creating interactive and data-driven web applications.

Course Outcome:

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

CO1: Design structured web pages using HTML, CSS, and add interactivity using JavaScript.

CO2: Implement database connectivity in Java using JDBC for data operations.

CO3: Develop server-side applications using Servlets with session management and JDBC integration.

CO4: Create dynamic web applications using JSP with scripting elements and MVC structure.

CO5: Build database-driven web solutions using PHP and MySQL, including form handling and data manipulation.

Course Content:

Topics	Hours
Unit I	6
Introduction to HTML : HTML Common tags- Block Level and Inline Elements, Lists, Tables, Images, Forms, Frames; Cascading Style sheets, CSS Properties; **Java Script:** Introduction to Java Script, Objects in Java Script, Dynamic HTML with Java Script, **Ancient Indian knowledge systems like Vedic chants and manuscripts exemplified structured formatting and layered information flow, resonating with the logic of web structuring using HTML, CSS, and dynamic scripting.**	
Unit II	6
JDBC: Data Base, Database Schema, A Brief Overview Of The JDBC Process, JDBC Driver Types, JDBC Packages, Database Connection, Associating The JDBC- ODBC Bridge With Database, Creating, Inserting, Updating And Deleting Data in Database Tables, Result Set, Metadata.	
Unit III	8
Web Servers and Servlets: Tomcat web server, Introduction to Servlets: Servlets, the Advantage of Servlets over "Traditional" CGI, Basic Servlet Structure, Simple Servlet Generating Plain Text, Compiling and Installing the Servlet, Invoking the Servlet, Lifecycle of a Servlet, The Servlet API, Reading Servlet parameters, Reading Initialization parameters, Context Parameters, Handling Http Request & Responses, Using Cookies-Session Tracking, Servlet with JDBC.	
Unit IV	
Introduction to JSP: The Problem with Servlet. The Anatomy of a JSP Page, JSP Processing, JSP Application Development: Generating Dynamic Content, Using Scripting Elements, Implicit JSP Objects, Declaring Variables and Methods , Sharing Data Between JSP pages, Users Passing Control and Data between Pages, JSP application design with JDBC, JSP Application Design with MVC.	6
Unit V	4
Introduction to PHP: Basics of PHP, Functions, Error Handling, Interaction between PHP and MySQL, Database using Forms,Using PHP to manipulate and Retrieve Data in MySQL.	

Suggested books:

1. Jon Duckett “Beginning Web Programming” WROX.
2. Marty Hall and Larry Brown “Core Servlets and Java Server pages Vol. 1: Core Technologies”, Pearson.

Suggested reference books

1. DanWoods and Gautam Guliani,”Open Source for the Enterprise: Managing Risks, Reaping Rewards”, O‟Reilly, Shroff Publishers and Distributors, 2005.
2. Sebesta,”Programming world wide web” Pearson.
3. Dietel and Nieto,“Internet and World Wide Web – How to program”,PHI/Pearson Education Asia.

Program: B.Tech

Semester: Sixth

Course: Web Technology Lab

Course Code: 3TECCS313P

L	T	P	C
0	0	2	1

Lab Exercises

1. Write a HTML program for the demonstration of Lists.
    a. Unordered List
    b. Ordered List
    c. Definition List
    d. Nested List
2. Write a HTML program for demonstrating Hyperlinks.
    a. Navigation from one page to another.
    b. Navigation within the page.
3. Write a HTML program for time-table using tables.
4. Write a HTML program to develop a static Home Page using frames.
5. Write a HTML program to develop a static Registration Form.
6. Write a HTML program to develop a static Login Page.
7. Write a HTML program to develop a static Web Page for Catalog.
8. Write a HTML program to develop a static Web Page for Shopping Cart.
9. Write HTML for demonstration of cascading stylesheets.
    a. Embedded stylesheets.
    b. External stylesheets.
    c. Inline styles.
10. Write a javascript program to validate USER LOGIN page.
11. Write a javascript program for validating REGISTRATION FORM
12. Write a program for implementing XML document for CUSTOMER DETAILS.
13. Write an internal Document Type Definition to validate XML for CUSTOMER DETAILS?
14. Write an external Document Type Definition to validate XML for CUSTOMER DETAILS?
15. Write an XML for person information and access the data using XSL.
16. Write an XML for student information and access second students data using DOM.
17. Write a program to display contents of XML file in a table using Extensible Style Sheets.

WEB TECHNOLOGIES LAB MANUAL

18. Write a simple servlet that displays a message.
19. Write a servlet that reads parameters from employee login page.
20. Write a servlet for creating a cookie and retrieving it.
21. Write a servlet for session tracking.
22. Write a JSP that reads parameters from user login page.
23. Write a JSP that reads a value, creates a cookie and retrieves it.
24. Write a JSP for session tracking.
25. Write a servlet that connects to the database and retrieves the data and displays it.

Program: B.Tech

Semester: Sixth

Course: Statistics for Artificial Intelligence

Course Code: 3TECCS319

L	T	P	C
3	0	0	3

Course Objective:

The objectives of this course are:

- To provide foundational knowledge of basic statistical tools for data exploration and summarization.
- To develop the ability to analyze relationships and distributions using statistical methods.
- To introduce inferential statistics including hypothesis testing and dimensionality reduction.
- To equip students with knowledge of probability theory and its application in statistical modeling.
- To introduce the basic concepts, techniques, and problem-solving strategies in Artificial Intelligence.

Course Outcome:

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

CO1: Apply statistical tools like histograms, measures of central tendency, and dispersion to explore and summarize data.

CO2: Analyze relationships between variables using covariance, correlation, and probability distributions.

CO3: Perform hypothesis testing and validation using statistical tests and dimensionality reduction techniques.

CO4: Demonstrate understanding of AI foundations, techniques, and their relevance to real-world problems.

CO5: Solve AI problems using search strategies like state space search, heuristic search, and hill climbing.

Course Content:

Topics	Hours
Unit I	8
Basics of Statistics : • Data exploration (histograms, bar chart, box plot, line graph, scatter plot) • Qualitative and Quantitative Data • Measure of Central Tendency (Mean, Median and Mode), • Measure of Positions (Quartiles, Percentiles and Quantiles), • Measure of Dispersion (Range, Median, Variance , and Standard deviation) **Nyaya Philosophy and Paninian Grammar as Ancient Foundations of Statistical Inference and Artificial Intelligence in India.**	
Unit II	8
Statistical Analysis : • Relationship between attributes: Covariance, Correlation Coefficient • Measure of Distribution (Skewness and Kurtosis) • Conditional probability • Probability distributions (Continuous and Discrete) • Density Functions and Cumulative functions	
Unit III	8
Inferential Statistics • Procedure for statistical testing • Test of Hypothesis (Concept of Hypothesis testing, Null Hypothesis and Alternative • Hypothesis) • Chi-Square test • Validation Techniques (Cross-Validations- Kfold, Stratified kfold) • Feature Reduction/Dimensionality reduction • Principal components analysis (Eigen values, Eigen vectors, Orthogonality)	

Unit IV	
Foundations of AI • Introduction to AI • Importance of AI • AI and its related field • AI Techniques • Problem space and search: Defining the problem as a state space search • Heuristic search techniques- best first search & depth first search • Hill climbing	6

Suggested books:

1. T. Veerarajan – Probability, Statistical, Random Processes 2nd Ed., TMH, New Delhi, 2003
2. Artificial Intelligence: A Modern Approach, 4th US edition by Stuart Russell and Peter Norvig

Suggested reference books

1. Basic Probability Theory - Robert B. Ash, Department of Mathematics, University of Illinois
2. E. Rich and K. Knight, "Artificial intelligence", TMH, 2nd ed., 1999.

Program: B.Tech

Semester: Sixth

Course: Data Mining

Course Code: 3TECCS318

L	T	P	C
3	0	0	3

Course Objectives:

The objectives of this course are:

- To understand data warehousing fundamentals, architecture, and OLAP concepts.
- To learn key data mining techniques including preprocessing and transformation.
- To explore association rule mining methods for pattern discovery.
- To study classification and clustering algorithms for predictive modeling.
- To get acquainted with advanced mining areas and ethical considerations.

Course Outcomes:

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

CO1: Explain data warehouse design, schemas, and OLAP operations.

CO2: Apply data preprocessing for effective knowledge discovery.

CO3: Use association rule algorithms like Apriori and FP-Growth.

CO4: Perform classification and clustering using standard algorithms.

CO5: Analyze advanced mining domains with awareness of privacy and ethics.

Course Content:

Topics	Hours
Unit I	6
Data Warehousing: Need for data warehousing , Basic elements of data warehousing, Data Mart, Data Warehouse Architecture, extract and load Process, Clean and Transform data, Star ,Snowflake and Galaxy Schemas for Multidimensional databases, Fact and dimension data, Partitioning Strategy- Horizontal and Vertical Partitioning, Data Warehouse and OLAP technology, Multidimensional data models and different OLAP Operations, OLAPServer: ROLAP, MOLAP, Data Warehouse implementation, Efficient Computation of Data Cubes, Processing of OLAP queries, Indexing data, **Knowledge Discovery in Ancient Indian Texts (like Vedas, Ayurveda, and Paninian Grammar) as Early Foundations of Data Mining and Pattern Discovery**	
Unit II	6
Data Mining: Data Preprocessing, Data Integration and Transformation, Data Reduction, Discretizaion and Concept Hierarchy Generation, Basics of data mining, Data mining techniques, KDP (Knowledge Discovery Process), Application and Challenges of Data Mining.	
Unit III	8
Mining Association Rules in Large Databases: Association Rule Mining, Single-Dimensional Boolean Association Rules, Multi-Level Association Rule, Apriori Algorithm, Fp- Growth Algorithm, Time series mining association rules, latest trends in association rules mining.	
Unit IV	6
Classification and Clustering: Distance Measures, Types of Clustering Algorithms, K-Means Algorithm, Decision Tree, Bayesian Classification, Other Classification Methods, Prediction, Classifier Accuracy, Categorization of methods, Outlier Analysis.	
Unit V	4
Introduction of Web Mining and its types, Spatial Mining, Temporal Mining, Text Mining, Security Issue, Privacy Issue, Ethical Issue.	

Suggested books:

1. Arun k Pujari “Data Mining Technique” University Press
2. Han,Kamber, “Data Mining Concepts & Techniques”,

Suggested reference books

1. M.Kaufman., P.Ponnian, “Data Warehousing Fundamentals”, John Wiley.
2. 4, M.H.Dunham, “Data Mining Introductory & Advanced Topics”, Pearson Education.
3. Ralph Kimball, “The Data Warehouse Lifecycle Tool Kit”, JohnWiley.
4. E.G. Mallach , “The Decision Support & Data Warehouse Systems”, TMH

Program: B.Tech

Semester: Sixth

Course: Knowledge Representation

Course Code: 3TECCS320

L	T	P	C
3	0	0	3

Course Objective:

The objectives of this course are:

- To introduce the role and importance of knowledge representation and first-order logic (FOL) in AI systems.
- To enable learners to express knowledge through structured vocabularies and facts in various forms.
- To explain resolution techniques, including propositional and first-order logic with quantifiers.
- To explore structured descriptions using object-oriented representation and description logics.
- To provide insights into modeling actions and planning using logical reasoning frameworks like STRIPS and situation calculus.

Course Outcome:

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

CO1: Apply FOL for knowledge representation and reasoning in AI systems.

CO2: Represent knowledge using structured vocabularies, facts, and entailments.

CO3: Solve logical expressions using resolution strategies in propositional and FOL.

CO4: Organize knowledge using frames and object-oriented approaches.

CO5: Design logical planning systems using STRIPS and situation calculus.

Course Content:

Topics	Hours
Unit I	6
Knowledge representation and First Order Logic Introduction - Use of Knowledge Representation in AI Systems, Methods for Knowledge Representation, Knowledge-based system - Knowledge representation- Reasoning - Role of Logic. Introduction to FOL - Syntax – Semantics-Pragmatics - Explicit and Implicit Belief, **Nyaya and Paninian Systems as Ancient Indian Frameworks of Knowledge Representation, Logic, and Inference for Artificial Intelligence**	
Unit III	5
Expressing Knowledge Knowledge Engineering - Vocabulary - Basic Facts - Complex Facts - Terminological Facts Entailments - Abstract Individuals - Other Sorts of Facts.	
Unit III	5
Resolution Resolution - The Propositional Case - Handling Variables and Quantifiers- Dealing with Computational Intractability	
Unit IV	8
Structured Descriptions Object-Oriented Representation- Objects and Frames, Description Language - Meaning and Entailment - Truth in an Interpretation – Entailment - Computing Entailments - Simplifying the Knowledge Base - Normalization - Structure Matching - The Correctness of the Subsumption Computation -Computing Satisfaction -	
Unit V	6
Actions and Planning Actions- The Situation Calculus- A Simple Solution to the Frame Problem- Complex Actions Planning - Planning in the Situation Calculus- The STRIPS Representation- Planning as a Reasoning Task, The Tradeoff between Expressiveness and Tractability	

Suggested books:

1. Ronald J. Brachman, Hector J. Levesque: Knowledge Representation and Reasoning, MorganKaufmann, 2004.
2. Deepak Khemani. A First Course in Artificial Intelligence, McGraw Hill Education (India), 2013

Suggested reference books

1. Murray Shanahan: A Circumscriptive Calculus of Events. Artificial Intelligence 77(2), pp. 249-284, 1995.

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Semester VII

SEMESTER VII														
S. No		**BROAD CATEGORY**	**CATEGORY**	**CODE**	**COURSE TITLE**	**Periods**			**Evaluation Scheme**				**SubjectTotal**	**Credit**
						L	**T**	**P**	**Assignment**	**TA**	**Total**	**ESE**		
1	6	Track Elective	Core Courses (CC)-Major		Track Elective IV	3	0	0	20	10	30	70	100	3
2		Track Elective	Core Courses (CC)-Major		Track Elective V	3	0	2	20	10	30	70	150	4
3		Track Elective	Core Courses (CC)-Major		Track Elective VI	3	0	0	20	10	30	70	100	3
4		Professional Core Course	Core Courses (CC)-Major	3PCCCS401	Introduction to Cyber Security	3	0	0	20	10	30	70	100	3
5		Open ElectiveCourse	Multidisciplinary Course (MDC)		Open Elective II / MOOCs II	3	0	0	20	10	30	70	100	3
PRACTICAL /SESSIONAL														
2	6	Project	Project	3PROJCS401	Project-II	0	0	8			100	100	200	4
											TOTAL		**650**	**20**

Program: B. Tech

Semester: Seven

Course: Introduction to Cyber Security

Course code: 3PCCCS401

L	T	P	C
3	0	0	3

Course Objective:

The objectives of this course are to:

- Understand the foundational principles of cybersecurity, including threats, vulnerabilities, attacks, and controls.
- Analyze and classify different types of cybercrimes from local and global perspectives, including cloud and mobile device-related crimes.
- Develop hands-on skills in identifying and mitigating cyber-attacks through vulnerability scanning, penetration testing, and network analysis tools.
- Understand the integration of quantum cryptography with cybersecurity, including emerging paradigms like Quantum Key Distribution (QKD) and Post-Quantum Cryptography.
- Gain knowledge of cyber laws and legal frameworks, including the Indian IT Act 2000, to recognize and respond to cyber offenses and regulatory requirements.

Course Outcomes:

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

CO1: Identify and analyze various cybersecurity threats, vulnerabilities, and associated attack vectors.

CO2: Demonstrate proficiency in conducting network vulnerability assessments and using cybersecurity tools such as OpenVAS, Metasploit, Netcat, and Socat.

CO3: Apply digital forensic techniques to collect, preserve, and analyze digital evidence following legal and ethical standards.

CO4: Explain and evaluate the role of quantum cryptography and post-quantum cryptographic approaches in enhancing cybersecurity.

CO5: Interpret and apply cybercrime laws, including the Indian IT Act 2000, and develop appropriate strategies for incident response and cyber investigation.

Topics	Hours
Unit I	6
Introduction to Cyber Security Computer Security: Introduction: Basic concepts and terminology in cybersecurity, Motivation to study cybersecurity, real world examples of cyberattacks, Branches of cybersecurity, Threats, Harm, Vulnerabilities, Controls, Authentication, Access Control and Cryptography, **Kautilya's Arthashastra and Ancient Indian Espionage Practices as the Foundations of Cybersecurity, Threat Modeling, and Legal Frameworks.**	
Unit II	6
Cyber Attacks and Defense Malware: Virus, worms, trojan horse, rootkit, zombie, bot, botnet, ransomware, Bug: buffer overflow, integer overflow, TOCTTOU, covert channel, Security model: threat model, trust model, trusted computing base, Security principles and countermeasures. **Web Security:** Security architecture of World Wide Web, Security Architecture of Web Servers, and Web Clients Browser Attacks, Web Attacks Targeting Users: Cross Site Scripting Attacks, Cross Site Request Forgery, SQL Injection Attacks, Obtaining User or Website Data, Email Attacks, Content Security Policies (CSP) in web Session Management and User Authentication, Session Integrity	
Unit III	6
Network Vulnerabilities: Overview of vulnerability scanning, Open Port / Service Identification, Banner /Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples, OpenVAS. Networks Vulnerability Scanning (Netcat, Socat), Network Sniffers and Injection DOS and DDOS attack, Attack on wireless Networks.	
Unit IV	6
Web Application and Network Defense Tools: **Scanning for web vulnerabilities tools:** Nikto, W3af, HTTP utilities - Curl, OpenSSL and Stunnel. Application Inspection tools – Zed Attack Proxy, Sqlmap, DVWA, Webgoat. Password Cracking and Brute-Force Tools: John the Ripper, L0htcrack, Pwdump	

Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs Firewall, How a Firewall Protects a Network, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding, VPN: the basic of Virtual Private Networks, Firewall: Introduction, Linux Firewall, Windows Firewall, Snort: Intrusion Detection System.	
Unit V	6
Introduction to Cyber Crime, law and Investigation: **Cyber Crimes:** Types of Cybercrime, Hacking, Attack vectors, Cyberspace and Criminal Behavior, Clarification of Terms, Traditional Problems Associated with Computer Crime, Introduction to Incident Response, Digital Forensics, Computer Language, Network Language, Realms of the Cyber world. **Internet crime and Act:** A Brief History of the Internet, Recognizing and Defining Computer Crime, Contemporary Crimes, Computers as Targets, Contaminants and Destruction of Data, Indian IT ACT 2000.	

Text books:

- William Stallings and Lawrie Brown, Computer Security: Principles and Practice, Boston, Massachusetts: Pearson Education, 2018.

Reference books:

- Dafydd Stuttard and Marcus Pinto, The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, Indianapolis, Indiana: Wiley Publishing, 2011.
- Daniel J. Bernstein, Johannes Buchmann, and Erik Dahmen (Editors), Post-Quantum Cryptography, Berlin, Germany: Springer, 2009.
- Thomas J. Holt, Adam M. Bossler, and Kathryn C. SeigfriedSpellar, Cybercrime and Digital Forensics: An Introduction, London, United Kingdom: Routledge, 2017.
- Chris McNab, Network Security Assessment: Know Your Network, Sebastopol, California: O'Reilly Media, 2016.

Program: B. Tech

Semester: Seven

Course: Project-II

Course code: 3PROJCS401

L	T	P	C
0	0	8	4

The knowledge gained in previous courses are to be applied to a practical problem in various disciplines Demonstrate their ability to work independently and collaboratively.

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SPECIALIZATION IN ARTIFICIAL INTELLIGENCE

TRACK ELECTIVE – IV

TRACK ELECTIVE – V

TRACK ELECTIVE – VI

Program: B.Tech

Semester: Seven

Course: Internet of Things

Course code: 3TECCS401

L	T	P	C
3	0	0	3

Course Objective:

The objectives of this course are:

- To introduce the fundamental concepts, applications, and enabling technologies of the Internet of Things (IoT).
- To explain the layered and protocol architecture of IoT and the role of various communication technologies.
- To describe networking protocols, service discovery, and routing mechanisms specific to IoT and sensor networks.
- To explore IoT platforms, cloud/fog integration, analytics tools, and address privacy and security concerns.

Course Outcomes:

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

CO1: Explain the definition, characteristics, growth, application areas, and enabling technologies of the Internet of Things (IoT).

CO2: Describe the layered and protocol architecture of IoT and evaluate various IoT communication protocols.

CO3: Analyze and compare networking protocols, service discovery methods, and routing techniques used in IoT and sensor networks.

CO4: Utilize IoT platforms and analytics tools for data handling and visualization, while addressing privacy and security issues.

Course Content:

Topics	Hours
Unit I	6
Introduction to IoT: Introduction and Definition of Internet of Things, IoT growth – A statistical view, Application areas of IoT, Characteristics of IoT,Things in IoT, IoT stack, Enabling technologies, IoT challenges, IoT levels, **Ancient Indian Water Management, Communication, and Astronomical Observation Systems as Early Models of Connected Networks Inspiring the Internet of Things**	
Unit II	8
Internet of Things– Architecture and Communication Protocol Layered Architecture for IoT, Protocol Architecture of IoT, Infrastructure Protocols: MAC protocols for sensor network, S-MAC, IEEE 802.15.4, Near Field Communication **(**NFC), RFID, ZigBee, Bluetooth Low Energy (BLE),IPv6 over LowPower Wireless Personal Area Networks (6LoWPAN), Long Term Evolution-Advanced, Z-Wave, Components of ZWave Network, Protocols for IoT Service Discovery: DNS service discovery, multicast domain name system.	
Unit III	8
Internet of Things – Networking Protocol Constrained Application Protocol (CoAP), Message Queue Telemetry Transport (MQTT), Extensible Messaging and Presence Protocol (XMPP), Advanced Message Queuing Protocol (AMQP), Data Distribution Service (DDS), Service Discovery Protocols, Routing Protocol for Low Power and Lossy Networks (RPL), sensor networks, unique constraints and challenges, advantages of ad-hoc/sensor network, sensor network architecture, data dissemination and gathering protocol.	
Unit IV	8
Platforms for IOT Applications and Analytics Role of the cloud and fog resources in the delivery of IoT services**,** The IoT Building Blocks, Connected Devices, IoT or Sensor Data Gateway, The IoT Data Analytics Platforms: IBM Watson IoT Platform, Splunk Software for IoT Data, Amazon Web Service IoT Platform, Azure IoT Hub, The IoT Data Virtualization Platforms, IoT Data Visualization Platform, Security and Privacy in IoT	

Text books:

1. Vasudevan, Nagrajan and Sundaram - “Internet of Things”, Wiley India.

2. Pethuru Raj and Anupama C. Raman, “The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017.

Reference books:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle – “From Machine-To-Machine to The Internet of Things: Introduction to A New Age of Intelligence”, Academic Press.

2. Micheael M. – “Arduino Cookbook” - O’reilly Publication.

3. Olivier Hersent, David Boswarthick, Omar Elloumi - “The Internet of Things – Key applications and Protocols”, Wiley.

Program: B.Tech

Semester: Seven

Course: Artificial Intelligence

Course code: 3TECCS402

L	T	P	C
3	0	0	3

Course Objective:

The objectives of this course are:

- To provide a strong foundation in the history, evolution, and architecture of intelligent agents and their environments.
- To develop problem-solving abilities through search techniques, including adversarial and heuristic approaches.
- To introduce knowledge representation and reasoning using logic, constraint satisfaction, and probabilistic methods.
- To familiarize students with classical planning techniques and ontological approaches for knowledge representation.

Course Outcomes:

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

CO1: Understand the fundamental principles of Artificial Intelligence, including agent structures and their interaction with environments.

CO2: Apply uninformed and informed search strategies, and evaluate adversarial search algorithms such as alpha-beta pruning.

CO3: Solve problems using constraint satisfaction, logical inference, and statistical reasoning techniques such as Bayesian networks and fuzzy logic.

CO4: Design AI systems using classical planning algorithms, knowledge representation techniques, and multi-agent planning strategies.

Course Content:

Topics	Hours
Unit I	6
History and Foundations of AI, Rational Intelligent Agents, Agents and Environments, Nature of Environments, Structure of Agents, **Nyaya Philosophy and Paninian Grammar as Ancient Indian Foundations of Logic, Inference, and Intelligent Problem-Solving in Artificial Intelligence.**	
Unit II	8
Problem Solving by Search: Uninformed and Informed Search Strategies, Heuristic Functions; Adversarial Search: Games, Optimal Decisions in Games, Alpha-Beta Pruning. Heuristic Search Techniques: Generate and Test – Hill Climbing – Best-First Search – Problem Reduction.	
Unit III	8
Constraint Satisfaction Problems, Inference in CSPs, Backtracking Search; Knowledge-Based Agents, Propositional and First-Order Logic, Resolution Theorem Proving, Unification Forward and Backward Chaining. . Statistical Reasoning: Probability and Baye's Theorem – Certainty Factors and Rule- based Systems – Bayesian Networks – Dempster-Shafer Theory – Fuzzy Logic	
Unit IV	8
Classical Planning: Algorithms for Planning, Planning Graphs, Hierarchical Planning, Planning and Acting in Nondeterministic Domain, Multi-Agent Planning; Knowledge Representation: Ontological Engineering, Categories and Objects, Events, Reasoning with Default Information.	

Text books

1. Russell, Stuart Jonathan, Norvig, Peter, Davis, Ernest. Artificial Intelligence: A Modern Approach. United Kingdom: Pearson, 2010.
2. Deepak Khemani. A First Course in Artificial Intelligence. McGraw Hill Education (India), 2013. Denis Rothman. Artificial Intelligence by Example, Packt, 2018.

References:

1. E. Rich and K. Knight, Artificial Intelligence, Addison Wesley, 1990
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learnng, MIT Press, 2016
3. Daphne Koller and Nir Friedman, Probabilistic Graphical Models: Principles and Techniques, MIT
Press, 2009.
4. Sutton and Barto. Reinforcement Learning: An Introduction. Available free online.
5. Hastie, Tibshirani, and Friedman. The elements of statistical learning. Available free online

Program: B.Tech

Semester: Seven

Course: Artificial Intelligence Lab

Course code: 3TECCS402P

L	T	P	C
0	0	2	1

Artificial Intelligence Lab:

1. Write a program to implement the Hill Climbing problem
2. Write a program to implement the Towers of Hanoi problem
3. Write a program to implement the Missionaries and Cannibals problem
4. Write a program to implement the 8 queen's problem
5. Write a program to implement the A* Algorithm
6. Write a program to implement the Breadth first algorithm
7. Write a program to implement the Depth first algorithm
8. Write a program to implement the predicate logic
9. To study various datasets used to train the AI models.
10. To implement linear classification.
11. To implement non-linear classification.
12. To implement feed-forward neural network.
13. To implement back-propagation neural network.
14. To study and implement CNN.
15. To study and implement RNN and LSTM based sequence learning models.
16. To study and implement transformers.

Program: B.Tech

Semester: Seven

Course: Supervised Machine Learning

Course code: 3TECCS410

L	T	P	C
3	0	0	3

Course Objective:

The objectives of this course are:

- To introduce the fundamentals and types of machine learning with a focus on supervised learning techniques and performance evaluation.
- To develop understanding of linear models such as regression and logistic regression, along with optimization techniques and regularization.
- To explore non-linear models, ensemble methods, and algorithms like decision trees, SVMs, k-NN for classification and regression tasks.
- To provide foundational knowledge of neural networks, deep learning, and ensure awareness of ethical considerations and model interpretability.

Course Outcomes:

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

CO1: Apply supervised learning techniques for data preprocessing, model development, and performance evaluation using classification and regression metrics.

CO2: Build and optimize linear models using regression analysis, apply regularization methods, and perform hyper parameter tuning.

CO3: Implement and evaluate non-linear models, ensemble methods, and instance-based algorithms for solving complex machine learning problems.

CO4: Develop deep learning models using neural networks and interpret them using explain ability techniques while addressing ethical concerns such as bias and fairness.

Course Content:

Topics	Hours
Unit I	8
Introduction to Supervised Learning **Introduction : O**bjectives and expectations ,Introduction to Machine Learning .**Types of Machine Learning:** Supervised, Unsupervised, and Reinforcement Learning, **Fundamentals of Supervised Learning :** Definition and concepts of supervised learning ,Applications of supervised learning , **Data Preprocessing and Exploration :** Data collection and data sources, Data cleaning and handling missing values ,Exploratory data analysis (EDA) , **Performance Metrics and Evaluation:** Evaluation metrics for classification: accuracy, precision, recall, ,**Evaluation metrics for regression:** MSE, RMSE, MAE, R^2 score ,Cross-validation techniques, **Ancient Indian Predictive Systems: From Panini's Grammar Rules and Ayurvedic Diagnosis to Modern Supervised Learning Models.**	
Unit II	8
Linear Models and Optimization **Linear Regression :** Simple and multiple linear regression ,Assumptions of linear regression ,Least squares method ,Model evaluation and interpretation , **Logistic Regression:** Logistic regression for binary classification , Regularization techniques: L1 (Lasso) and L2 (Ridge) , **Gradient Descent and Optimization :** Introduction to optimization algorithms ,Gradient descent: batch, stochastic, Cost functions for regression and classification , **Regularization and Model Selection:** Over fitting and under fitting ,**Regularization Techniques**: Lasso, Ridge, and Elastic Net ,Model selection and hyper parameter tuning ,Grid search and random search	
Unit III	8
Non-Linear Models and Ensembles **Decision Trees:** Introduction to decision trees ,**Splitting criteria**: entropy ,Pruning techniques ,Advantages and limitations of decision trees ,**Ensemble Methods :** Introduction to ensemble learning ,Bagging and Bootstrap Aggregating ,**Random Forests:** construction and parameter tuning , **Boosting**: AdaBoost , Gradient Boosting , **Support Vector Machines:** Introduction to Support Vector Machines (SVMs) ,Linear SVM and kernel trick ,Non-linear SVM with kernel functions , **k-Nearest Neighbors :** Introduction to k-Nearest Neighbors (k-NN) ,**Distance metrics:** Euclidean, Manhattan ,Choosing the value of k ,Pros and cons of k-NN	
Unit IV	6
Neural Networks and Deep Learning **Neural Networks and Deep Learning:** Basics of neural Networks, Introduction to deep Learning, **Training neural networks:** forward and backward Propagation, Activation functions and loss functions, **Model Interpretability and Explain ability:** Importance of Model Interpretability, **Techniques for model interpretability**: SHAP, LIME, Fairness and ethics in machine learning, Bias and variance trade-off	

Text Book:

1) Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, “Machine Learning”, Pearson Education

2) Anuradha Srinivarasaraghavan, Vincy Joseph, “Machine Learning”, Wiley India

Reference Books:

1) Tom M Mitchell, “Machine Learning”, McGraw Hill
2) "Introduction to Statistical Learning" by Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani

3) "Pattern Recognition and Machine Learning" by Christopher M. Bishop

Program: B.Tech

Semester: Seven

Course: Deep Learning

Course code: 3TECCS411

L	T	P	C
3	0	0	3

Course Objective:

The objectives of this course are:

- To introduce neural networks, CNNs, and their use in computer vision.
- To explore RNNs, LSTMs, GANs, and transfer learning.
- To understand NLP using embedding, attention, and reinforcement learning.
- To explain auto encoders, VAEs, and discuss ethics and future AI trends.

Course Outcomes:

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

CO1: Design and train neural networks and CNNs using Tensor Flow/PyTorch.

CO2: Use RNNs, LSTMs, and GANs for NLP and image tasks with transfer learning.

CO3: Build NLP apps using embedding, sequence models, and reinforcement learning.

CO4: Apply auto encoders/VAEs and address ethical aspects in deep learning.

Course Content:

Topics	Hours
Unit I:	8
Introduction to Deep Learning **Foundations of Neural Networks:** Introduction to artificial neural networks (ANNs) Perceptions and activation functions, Training neural networks: gradient descent and back propagation, **Deep Neural Networks (DNNs):** Architectural principles of DNNs, Deep learning frameworks (TensorFlow, PyTorch) ,Regularization techniques (dropout, L2 regularization) **Convolution Neural Networks (CNNs) :** CNN basics and architecture ,Applications of CNNs in image recognition and computer vision ,Advanced CNN architectures (e.g., ResNet, VGG), **Layered Learning in Ancient Indian Knowledge Systems: From Yogic Consciousness and Panini's Grammar to Modern Deep Neural Networks**	
Unit II	8
Recurrent Neural Networks (RNNs) **Recurrent Neural Networks (RNNs) :**Introduction to sequence modeling ,LSTM and GRU networks ,Applications of RNNs in natural language processing (NLP) , **Generative Adversarial Networks (GANs):**Introduction to generative models ,GAN architecture and training process ,Applications of GANs in image generation and synthesis , **Transfer Learning and Fine-Tuning :** Transfer learning principles ,Pre-trained models (e.g., BERT, GPT) and their applications ,Fine-tuning strategies for specific tasks.	
Unit III	7
Deep Learning for Natural Language Processing (NLP) **Deep Learning for Natural Language Processing (NLP) :**Word embeddings (Word2Vec, GloVe) ,Text classification and sentiment analysis ,Sequence-to-sequence models and attention mechanisms , **Deep Reinforcement Learning :** Introduction to reinforcement learning (RL) ,Deep Q-learning and policy gradients ,Applications of RL in gaming and robotics	
Unit IV	7
Autoencoders and Variation Autoencoders (VAEs) **Autoencoders and Variation Autoencoders (VAEs):** Principles of auto encoders, Variational autoencoders and generative modeling, Applications in dimensionality reduction and anomaly detection, **Ethical Considerations and Future Trends:** Ethical implications of deep learning, Bias and fairness in AI, Future trends in deep learning research and applications	

Text Book:

1. "Deep Learning", Ian Goodfellow, Yoshua Bengio and Aaron Courville, published by MIT Press,UK, 2017 Series

2. Deep Learning with Keras: The Textbook by Antonio Gulli and Sujit Pal, PacktPublishing Ltd, Birmingham, UK, April 2017

Reference Book:

1. Deep Learning with Tensor Flow, The Textbook by Giancarlo Zaccone, Md. Rezaul Karim, and Ahmed Menshawy, Packt Publishing Ltd, Birmingham, UK, April 2017.

Program: B. Tech

Semester: Seven

Course: Natural Language Processing

Course code: 3TECCS412

L	T	P	C
3	0	0	3

Course Objective:

The objectives of this course are:

- To introduce core concepts of NLP, including language models and tokenization techniques.
- To understand word-level analysis using N-grams, PoS tagging, and statistical methods.
- To explore syntactic parsing using CFGs, dependency grammars, and probabilistic models.
- To study semantic processing through word sense disambiguation and logic-based representation.
- To examine discourse analysis methods and utilize lexical resources in NLP applications.

Course Outcomes:

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

CO1: Apply language models and string-processing using regular expressions and finite-state automata.

CO2: Perform word-level analysis with N-grams, PoS tagging, HMM, and Maximum Entropy models.

CO3: Design and evaluate parsers using CFGs, feature structures, and probabilistic approaches.

CO4: Implement semantic analysis through word sense disambiguation and logic-based representations.

CO5: Use NLP tools like WordNet and Treebanks for discourse analysis and co-reference resolution.

Course Content:

Topics	Hours
Unit I	5
Introduction Origins and challenges of NLP – Language Modeling: Grammar based LM, Statistical LM - Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance, **From Panini's Ashtadhyayi to Modern NLP: Ancient Indian Grammar, Semantics, and Discourse as Foundations of Language Technologies**	
Unit II	7
Word Level Analysis Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.	
Unit III	6
Syntactic Analysis Context-Free Grammars, Grammar rules for English, Tree banks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs - Feature structures, Unification of feature structures.	
Unit IV	7
Semantics and Pragmatics Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, sectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.	
Unit V	5
Discourse Analysis and Lexical Resources Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Co-reference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, Word Net, Prop Bank, Frame Net, Brown Corpus, British National Corpus (BNC).	

Textbook:

1. Daniel Jurafsky and James H Martin. *Speech and Language Processing, 2e*, Pearson Education, 2009

Reference Books:

1. James A.. *Natural language Understanding 2e*, Pearson Education, 1994

2. Bharati A., Sangal R., Chaitanya V.. *Natural language processing: a Paninian perspective*, PHI, 2000

3. Steven Bird, Ewan Klein, Edward Loper, *Natural Language Processing with Python – Analyzing Text with the Natural Language Toolkit* **(O'Reilly 2009, website 2018)**

Program: B.Tech

Semester: Seven

Course: AI for Games

Course code: 3TECCS406

L	T	P	C
3	0	0	3

Course Objectives:

The objectives of this course is to:

- To introduce core concepts of Artificial Intelligence and its role in game development.
- To explain AI movement algorithms for game agents, including kinematic and dynamic behaviors.
- To explore pathfinding methods such as A*, heuristics, and obstacle avoidance techniques.
- To understand AI decision-making using behavior trees, GOAP, and search-based strategies.
- To expose students to modern Game AI techniques like procedural content generation and neural networks.

Course Outcomes:

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

CO1: Describe the application of AI in games and implement agent movement and behavior systems.

CO2: Develop and apply movement algorithms including steering and group behaviors for game agents.

CO3: Integrate pathfinding with navigation systems and implement obstacle avoidance.

CO4: Design decision-making architectures using decision trees, behavior trees, and strategic AI models.

CO5: Apply advanced Game AI techniques like procedural generation and neural networks in game design.

Course Content:

Topics	Hours
Unit I	5
Introduction to Game AI Introduction to Artificial Intelligence, Roles of AI in Game design, Game AI Interfaces (Movement, Path finding, Decision Making, Strategy), Complexity (Artificial Stupidity, Intelligent Mistakes) ,Game AI Inputs, Outputs, and Behaviors, The 2D Rigid body Agent, Steering Output, Variable Matching, **From Ancient Strategy Games to Modern Game AI: Algorithms for Movement, Pathfinding, Decision-Making, and Procedural Content Generation.**	
Unit II	5
Classical Techniques Movement Algorithms **Position Matching: Kinematic and Dynamic**-Seek Flee, Arrive, Orientation, Align, Wander, Velocity and Rotation Matching, **Delegation and Combination**-Interfaces, Blending, Arbitration. **Advanced Position and Orientation Matching**-Pursue, Evade, Face, Group **Movement**-Separation, Flocking.	
Unit III	6
Path finding Algorithms **Structure of Path finding Algorithms**- Directed Weighted Graphs, The Family of Search Algorithms ,**A* and Heuristics**-Performance, Design, **Abstraction Schemes**-Lifting and Grounding (Tile Graph, Navmesh), Path Follow Movement, **From Path finding to Movement**-The Steering Pipeline, Obstacle and Collision Avoidance.	
Unit IV	7
Decision Making Algorithms and Strategy Algorithms **Structure of Decision Making Algorithms**-Actions, Action Manager, **Decision Trees**-Nodes (Decisions, Actions), Design, Performance ,**Behavior Trees**-Architecture, Nodes, Design ,**Goal Oriented Action Planning**-States, Goals, Algorithm **,Structure of Strategy Algorithms**-Blackboard, Utility Theory, Game Playing-Minimax, Alpha-beta Pruning, **Monte-Carlo Tree Search**-Algorithm, Improving Performance, **Coordinated Action**-Multi-tier AI, Influence Maps.	
Unit V	7
Modern Techniques **Structure of Procedural Content Generators**-Content Selection v. Generation, Expressive Range, **Pseudorandom Number Generation**-Halton Sequence, Poisson Disk, Kaleidoscope Effect , **Content Selection**-L-systems, Grammars, Randomness, **Content Generation**-Parametric Systems, Search-based Methods ,**Decision Tree Learning**-ID3 Algorithm, **Artificial Neural Networks**-Credit Assignment, Feed forward and Back propagation, Error Term, **Deep Learning**-Overview, Architectures.	

Textbooks and printed resources (Recommended):

1. Millington, Ian. Artificial Intelligence for Games (3rd Ed.). CRC Press, 2019.
2. Funge, John Artificial Intelligence for Games. CRC Press 2009
3. Buckland, Matt Programming Game AI by Example. Wordware Publishing. 2005.

Suggested books:

- Millington's Artificial Intelligence for Games

Program: B. Tech

Semester: Seven

Course: AI for Games Lab

Course code: 3TECCS406P

L	T	P	C
0	0	2	1

This lab will introduce students to the basic principles and techniques of artificial intelligence (AI) in the context of game development. Students will learn about different AI strategies and how to implement them to create intelligent behaviors in games.

Prerequisites

- Basic knowledge of programming (preferably in C# or Python).
- Familiarity with a game development platform (Unity or Unreal Engine).

Detailed of Lab Practices

1. Write a program to implement Path finding with A* Algorithm
2. Write a program to implement Finite State Machines (FSM) for NPC Behavior
3. Write a program to implement Decision-Making with Behavior Trees
4. Write a program to implement First Person Shooter Game
5. Write a program to implement Real Time Strategy (RTS) Game
6. Write a program to implement Role Playing Games (RPGs)
7. Write a program to implement Plat former Game
8. Write a program to implement Tic Tac Toe Game
9. Write a program to implement God Games
10. Write a program to implement Sports Games
11. Write a program to implement Hidden Door Games
12. Write a program of The Case of 'Angry Pumpkins' Games
13. Write a program to implement **Storytelling** Games
14. Write a program to implement Decision-Making with Behavior Trees

Semester VIII

SEMESTER VIII														
S.No.		**BROAD CATEGORY**	**CATEGORY**	**CODE**	**COURSE TITLE**	**Periods**			**Evaluation Scheme**				**SubjectTotal**	**Credit**
						L	**T**	**P**	**Assignment**	**TA**	**Total**	**ESE**		
1	6	Track Elective	Core Courses (CC)-Major		Track Elective VII	4	0	0	20	10	30	70	100	4
2		Open ElectiveCourse	Core Course (CC)-Minor		Open Elective-III / MOOCs III	3	0	0	20	10	30	70	100	3
3				3UMC101	Managing Personal Finance##	2	0	0			50	0	50	0
PRACTICAL /SESSIONAL														
1	6	Project	Project	3PROJCS402	Project-III	0	0	16			100	100	200	8
											TOTAL		**450**	**15**

Program: B. Tech

Semester: Eight

Course: Project-III

Course code: 3PROJCS402

L	T	P	C
0	0	16	8

The knowledge gained in previous courses are to be applied to a practical problem in various disciplines Demonstrate their ability to work independently and collaboratively.

JHARKHAND Rai University
RANCHI

SPECIALIZATION IN ARTIFICIAL INTELLIGENCE

TRACK ELECTIVE – VII

JHARKHAND Rai University
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L	T	P	C
4	0	0	4

Program: B. Tech
Semester: Eight
Course: Computer Vision
Course code: 3TECCS421

Course Objectives:

The objectives of this course is to:

- To provide foundational understanding of computer vision concepts, image formation, and camera geometry.
- To explore feature detection and matching techniques used in object tracking, animation, and shape analysis.
- To introduce segmentation and alignment methods for analyzing and processing image regions and features in 2D and 3D.
- To develop the ability to recognize objects and scenes using detection, classification, and modeling techniques.

Course Outcomes:

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

CO1: Understand the principles of image formation and camera models in computer vision systems.

CO2: Apply feature detection, description, and matching techniques in real-world vision applications.

CO3: Implement segmentation and feature-based alignment for tasks such as medical imaging and geometric calibration.

CO4: Perform object and face recognition using statistical models and apply them in practical recognition tasks.

Course Content:

Topics	Hours
Unit I	8
Introduction What is computer vision, a brief history, Image Formation, Geometric primitives and transformations, Photometric image formation, the digital camera, **From Sushruta's Optics to Face Recognition: How Ancient Knowledge of Vision Shapes Modern Computer Vision**	
Unit II	10
Feature detection and matching Points and patches, Feature detectors, Feature descriptors, Feature matching, Feature tracking, Application: Performance-driven animation, Edges, Application: Edge editing and enhancement, Lines, Application: Rectangle detection.	
Unit III	12
Segmentation Active contours, Split and merge, Mean shift and mode finding, Normalized cuts, Graph cuts and energy-based methods, Application: Medical image segmentation. **Feature-based alignment:** 2D and 3D feature-based alignment, Pose estimation, Geometric intrinsic calibration, Calibration patterns, Vanishing points, Application: Single view metrology, Rotational motion, Radial distortion.	
Unit IV	10
Recognition Object detection, Face detection, Pedestrian detection, Face recognition, Eigen faces, Active appearance and 3D shape models, Application: Personal photo collections, Instance recognition, Category recognition, Context and scene understanding.	

Text Books:

1. Richard Szeliski," Computer Vision: Algorithms and Applications", Springer,2010.

2. Rafael C. Gonzalez "Digital Image Processing", Pearson Education; Fourth edition (2018)

Reference Books:

1. Forsyth/Ponce," Computer Vision: A Modern Approach",Pearson Education India;2ndedition(2015)

2. S.Nagabhushana,"Computer Vision and Image Processing", New Age International Pvt Ltd; First Edition(2005)

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L	T	P	C
4	0	0	4

Program: B. Tech

Semester: Eight

Course: Unsupervised Machine Learning

Course code: 3TECCS422

Course Objectives:

The objectives of this course is to:

- To introduce the fundamentals of unsupervised learning and clustering techniques along with their evaluation methods.
- To develop an understanding of dimensionality reduction techniques and their applications in simplifying data while preserving information.
- To explore techniques for anomaly and novelty detection and their real-world applications.
- To provide knowledge of advanced unsupervised learning methods including density estimation, association rules, and clustering in high-dimensional data.

Course Outcomes:

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

CO1: Understand and implement various clustering algorithms and evaluate their performance using internal and external metrics.

CO2: Apply dimensionality reduction techniques such as PCA and manifold learning methods to analyze and visualize high-dimensional data.

CO3: Identify and apply methods for detecting anomalies and novelties in datasets across various domains.

CO4: Use advanced unsupervised techniques like GMM, KDE, and association rule mining to extract meaningful patterns from complex data.

Course Content:

Topics	Hours
Unit I	**8**
Introduction to Unsupervised Learning **Overview of Machine Learning :** Definition and types of machine learning (supervised, unsupervised, reinforcement learning) ,Importance and applications of unsupervised learning, **Clustering Algorithms :** K-means clustering ,Hierarchical clustering ,Density-based clustering (e.g., DBSCAN) ,**Evaluation Metrics for Clustering :** Internal metrics (e.g., silhouette score) ,External metrics (e.g., Adjusted Rand Index), **Panchabhuta (Five Elements) and Ayurvedic Classification of Doshas as Early Clustering Models.**	
Unit II	**10**
Dimensionality Reduction Techniques **Principal Component Analysis (PCA) :** Principles and mathematical formulation ,Applications and interpretation of PCA results ,**Manifold Learning Techniques :** Isomap ,t-SNE (t-Distributed Stochastic Neighbor Embedding) ,**Evaluation of Dimensionality Reduction :** Assessing the quality of dimensionality reduction ,Understanding variance explained and reconstruction error	
Unit III	**12**
Anomaly Detection and Novelty Detection **Anomaly Detection:** Types of anomalies (point anomalies, contextual anomalies, collective anomalies), One-class SVM (Support Vector Machine), **Novelty Detection:** Overview of novelty detection Methods, Local Outlier Factor (LOF) Algorithm, Applications **of Anomaly and Novelty Detection:** Real-world use cases (e.g., fraud detection, fault detection in industrial systems)	
Unit IV	**10**
Advanced Unsupervised Learning **Density Estimation :** Gaussian Mixture Models (GMM) ,Kernel Density Estimation (KDE) ,**Association Rule Learning :** Apriori algorithm ,FP-growth algorithm ,**Clustering in High-Dimensional Data :** Challenges and techniques for clustering high-dimensional data ,Applications and case studies.	

References

- Bishop, C. M. (2006). Pattern Recognition and Machine Learning. Springer.
- Hastie, T., Tibshirani, R., & Friedman, J. (2009). The Elements of Statistical Learning: Data Mining, Inference, and Prediction. Springer.

Program: B.Tech

Semester: Eight

Course: Introduction to Robotics

Course code: 3TECCS423

L	T	P	C
4	0	0	4

Course Objectives:

The objectives of this course is to:

- To introduce fundamental concepts of robotics, including components, actuators, and motion systems.
- To provide an understanding of robot kinematics, dynamics, and programming methods.
- To familiarize students with various sensors, machine vision systems, and their integration in robotics.
- To explore robot control strategies, actuation systems, and feedback mechanisms.

Course Outcomes:

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

CO1: Describe the fundamental principles of robotics, including robot elements such as end effectors, drive systems, joints, and motion control techniques.

CO2: Apply direct and inverse kinematics and dynamic modeling techniques to analyze and solve robot motion and trajectory planning problems.

CO3: Evaluate and integrate different types of sensors and vision systems for enhancing robotic perception and decision-making.

CO4: Design and implement control strategies such as PID and advanced control laws using suitable actuators and feedback systems for robotic applications.

Course Content:

Topics	Hours
Unit I	8
Introduction to Robotics Introduction to Robotics: basic principles of robotics, engineering design processes, computer science and robotics. Robot Elements: End effectors-Classification, Types of Mechanical actuation, Gripper design, Robot drive system Types, Position and velocity feedback devices-Robot joints and links-Types, Motion interpolation, **Indian Temple Architecture & Cosmic Geometry as Early Models of Kinematics, Automata in Ancient India – From Yantras to Modern Robots.**	
Unit II	10
Robot Kinematics and Dynamics Fundamentals of Robot programming languages and machine logic, Robot kinematics – Basics of direct and inverse kinematics, Robot trajectories, 2D and 3D Transformation-Scaling, Rotation, Translation Homogeneous transformation. Control of robot manipulators – Point to point, Continuous Path Control, Robot programming, Dynamic Modeling: Equations of motion, Euler-Lagrange formulation.	
Unit III	12
Sensors and Vision System Introduction to Machine Vision and Artificial Intelligence, Sensor: Contact and Proximity, Position, Velocity, Force, Tactile etc, Introduction to Cameras: Camera calibration, Geometry of Image formation ,Euclidean transformations, Vision applications in robotics, Kinds of Sensors Used in Robotics : Acoustic Sensors -Optic Sensors –Pneumatic Sensors -Force /Torque Sensors, Optical Encoders.	
Unit IV	10
Robot Control & Robot Actuation Systems Basics of control: Transfer functions, Control laws: P, PD, PID, Non-linear and advanced controls, Actuators: Electric, Hydraulic and Pneumatic; Transmission: Gears, Timing Belts and Bearings, Parameters for selection of actuators, Fundamentals of kinematics: Line Following Algorithms; Feedback Systems.	

Text Books:

1. Stuart Russell, Peter Norvig, ―Artificial Intelligence: A modern approach, Pearson Education, India 2009.
2. Negnevitsky, M, ―Artificial Intelligence: A guide to Intelligent Systems‖,. Harlow: Addison-Wesley, 2011

References:

1. S. K. Saha, “Introduction to Robotics”, Tata McGraw Hill Education Pvt. Ltd., New Delhi.
2. R. K. Mittal, I. J. Nagrath, “Robotics and Control”, Tata McGraw-Hill Publishing Company Ltd.
3. J. J. Graig, “Introduction to Robotics – Mechanics and Control”, 2nd edition, Pearson Education, Inc.
4. Saeed Niku, “Introduction to Robotics – Analysis, Control, Applications”, John Wiley & Sons.

Program: B.Tech

Semester: Eight

Course: AI / ML Analyst

Course code: 3TECCS424

L	T	P	C
4	0	0	4

Course Objectives:

The objectives of this course is to:

- To provide foundational understanding of Artificial Intelligence, including its history, goals, and problem-solving methods.
- To impart knowledge on various knowledge representation techniques and reasoning mechanisms used in AI systems.
- To introduce machine learning algorithms for regression, classification, clustering, and dimensionality reduction.
- To develop practical understanding of deep learning architectures and Natural Language Processing (NLP) applications.

Course Outcomes:

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

CO1: Understand the fundamental principles of AI, its applications, and implement search algorithms like BFS, DFS, and A*.

CO2: Apply propositional and predicate logic for knowledge representation and perform inference using reasoning techniques.

CO3: Analyze and implement machine learning models such as regression, classification, clustering, and dimensionality reduction methods.

CO4: Design and train neural network models, and develop NLP-based applications such as sentiment analysis and text generation.

Course Content:

Topics	Hours
Unit I	10
Introduction to Artificial Intelligence: Definition and history of AI, Basic concepts and goals of AI, Applications and impact of AI in various fields **Problem-Solving and Search Algorithms:** Problem-solving methods in AI, Search algorithms: breadth-first search, depth-first, search, A* search, etc., Heuristic search techniques, **Problem-Solving in Ancient Indian Texts: From Chanakya to Chess-like Games**	
Unit II	10
Knowledge Representation and Reasoning: Representing knowledge in AI systems, Propositional and predicate logic, Inference rules and reasoning techniques. **Machine Learning Fundamentals:** Introduction to machine learning, supervised learning, unsupervised learning, and reinforcement learning, Evaluation metrics in machine learning.	
Unit III	10
Regression and Classification Algorithms: Linear regression, Logistic regression, Decision trees and random forests, Support Vector Machines (SVM), Naive Bayes classifier. **Clustering and Dimensionality Reduction:** K-means clustering, Hierarchical clustering, Principal Component Analysis (PCA),t-Distributed Stochastic Neighbor Embedding (t-SNE).	
Unit IV	10
Neural Networks and Deep Learning: Introduction to neural networks, Feedforward neural networks, Convolution Neural Networks (CNNs), Recurrent Neural Networks (RNNs),Training deep learning models. **Natural Language Processing (NLP):** Introduction to NLP, Text preprocessing techniques, Sentiment analysis, Named Entity Recognition (NER)- Text generation.	

Text Book:

1. Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, “Machine Learning”, Pearson
2. Education
3. Russell, Stuart Jonathan, Norvig, Peter, Davis, Ernest. Artificial Intelligence: A Modern Approach. United Kingdom: Pearson, 2010.

Reference Books:

1. Tom M Mitchell, “Machine Learning”, McGraw Hill
2. Anuradha Srinivarasaraghavan, Vincy Joseph, “Machine Learning”, Wiley India
3. Deepak Khemani. A First Course in Artificial Intelligence. McGraw Hill Education (India), 2013.

Denis Rothman. Artificial Intelligence by Example, Packt, 2018.