



RAMAIAH
Institute of Technology

CURRICULUM

**Outcome Based Education
(Academic Year 2023 – 2024)**

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

III & IV SEMESTER B.E.

RAMAIAH INSTITUTE OF TECHNOLOGY
(Autonomous Institute, Affiliated to VTU)
Bangalore – 560054.

About the Institute

Dr. M. S. Ramaiah a philanthropist, founded ‘Gokula Education Foundation’ in 1962 with an objective of serving the society. M S Ramaiah Institute of Technology (MSRIT) was established under the aegis of this foundation in the same year, creating a landmark in technical education in India. MSRIT offers 17 UG programs and 11 PG programs. All these programs are approved by AICTE. All eligible UG and PG programs are accredited by National Board of Accreditation (NBA). The institute is accredited with ‘A+’ grade by **NAAC in March 2021** for 5 years. University Grants Commission (UGC) & Visvesvaraya Technological University (VTU) have conferred Autonomous Status to MSRIT for both UG and PG Programs since 2007. The institute has also been conferred autonomous status for Ph.D. program since 2021. The institute is a participant to the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. The institute has 380 competent faculty out of which 67% are doctorates. Some of the distinguished features of MSRIT are: State of the art laboratories, individual computing facility for all faculty members, all research departments active with sponsored funded projects and more than 300 scholars pursuing Ph.D. To promote research culture, the institute has established Centre of Excellence for Imaging Technologies, Centre for Advanced Materials Technology, Centre for Antennas and Radio Frequency systems (CARFS), Center for Cyber Physical Systems, Schneider Centre of Excellence & Centre for Bio and Energy Materials Innovation. **Ramaiah Institute of Technology has obtained “Scimago Institutions Rankings” All India Rank 107 & world ranking 600 for the year 2022.**

The Entrepreneurship Development Cell (EDC) and Section 8 company “Ramaiah Evolute” have been set up on campus to incubate startups. **M S Ramaiah Institute of Technology is recognized by Atal Ranking of Institutions on Innovation Achievements (ARIIA), MoE, Govt. of India.** MSRIT has a strong Placement and Training department with a committed team, a good Mentoring/Proctorial system, a fully equipped Sports department, large air-conditioned library with good collection of book volumes and subscription to International and National Journals. The Digital Library subscribes to online e-journals from Elsevier Science Direct, IEEE, Taylor & Francis, Springer Link, etc. The Institute is a member of DELNET, CMTI and VTU E-Library Consortium. The Institute has a modern auditorium, recording studio, and several hi-tech conference halls with video conferencing facilities. The institute has excellent hostel facilities for boys and girls. MSRIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association.

As per the National Institutional Ranking Framework (NIRF), MoE, Government of India, Ramaiah Institute of Technology has achieved 78th rank among 1314 top Engineering Institutions & 23rd Rank among 105 School of Architecture in India for the year 2023.

About the Department

Year of Establishment	2021
Names of the Programme offered	UG: B.E. in Artificial Intelligence and Machine Learning

The Department of Artificial Intelligence and Machine Learning has eminent professor and faculty with the doctorate degree. The faculty has been publishing research papers in refereed journals and in conference proceedings. The department has state of the art laboratories and class rooms. Technical seminars, workshops and hackathons are conducted regularly for students. The department encourages the students to conduct and participate in extra- curricular/sports activities. The department conducts subjects with more of hands- on sessions and encourages students to take up MOOC based online courses in NPTEL, IIT Bombay, Coursera, Udacity and edX.

VISION OF THE INSTITUTE

To be an Institution of International Eminence, renowned for imparting quality technical education, cutting edge research and innovation to meet global socio- economic needs

MISSION OF THE INSTITUTE

MSRIT shall meet the global socio-economic needs through

1. Imparting quality technical education by nurturing a conducive learning environment through continuous improvement and customization
2. Establishing research clusters in emerging areas in collaboration with globally reputed organizations
3. Establishing innovative skills development, techno-entrepreneurial activities, and consultancy for socio-economic needs

QUALITY POLICY

We at M. S. Ramaiah Institute of Technology strive to deliver comprehensive, continually enhanced, global quality technical and management education through an established Quality Management System complemented by the synergistic interaction of the stake holders concerned

VISION OF THE DEPARTMENT

To provide quality technical education and research opportunities in the domain of Artificial Intelligence and Machine Learning and produce technical experts to face the challenges of present century

MISSION OF THE DEPARTMENT

1. To facilitate students in designing and developing systems, products or simulations using Artificial Intelligence and Machine Learning
2. To develop skills in graduates to become lifelong independent learners and be successful in industries, entrepreneur as well as research activities
3. To facilitate students with quality technical education through competitive curriculum along with communication skills and other soft skills for the overall development and attain sustainability.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

A B.E (Artificial Intelligence and Machine Learning) graduate of Ramaiah Institute of Technology should, within three to five years of graduation

PEO1: Develop intelligent software solutions using his/her education, constantly learning and contribute to the profession as an excellent employee or as an entrepreneur

PEO2: Be aware of the developments in the field of intelligent technology and promote research

PEO3: Demonstrate leadership qualities and work in interdisciplinary team in contributing to the betterment of the society

PROGRAMME OUTCOMES (POs):

The Outcomes of the Bachelor of engineering in Artificial Intelligence and Machine Learning Programme are as follows:

Engineering Graduates must 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 teamwork: 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 in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1: Understand the principles, architecture of computers, analysis, design and development of systems using concepts of Artificial intelligence & Machine Learning

PSO2: Apply the concepts of Artificial intelligence & Machine Learning to evaluate the results with appropriate tools and techniques

PSO3: Use Artificial Intelligence and Machine Learning models on data to develop software applications in emerging areas for better decision making

**Semester wise Credit Breakdown for B.E Degree Curriculum
Batch 2022-26**

Semester Course Category	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Total Credits
Basic Sciences (BSC)	08	08	03	03	--	--	--	--	22
Engineering Sciences (ESC)	09	08	--	--	--	--	--	--	17
Humanities, Social Sciences and Management (HSMC)	02	02	--	--	03	03	--	--	10
Ability Enhancement Course (AEC)	01	02	01	01	01	--	03	--	09
Universal Human Values (UHV)	--	--	02	--	--	--	--	--	02
Professional Core Courses (PCC)	--	--	11	12	12	06	04	--	45
Integrated Professional Core Course (IPCC)	--	--	04	04	03		04	--	15
Professional Elective Courses (PEC)	--	--	--	--	03	06	03	--	12
Institutional Open Elective Courses (IOE)	--	--	--	--	--	03	03	--	06
Internship (INT)	--	--	--	Yes	--	--	--	05	05
Mini Project / Project Work (PW)	--	--	--	--	--	04	03	10	17
Non Credit Mandatory Courses (NCMC)	--	--	Yes	--	Yes	--	--	Yes	--
Total Credits	20	20	21	20	22	22	20	15	160

SCHEME OF TEACHING III SEMESTER

Sl. No.	Course Code	Course Name	Teaching Department	Category	Credits				Total contact hours /week
					L	T	P	Total	
1	AI31	Laplace Transforms & Vector Space	Maths	BSC	2	1	0	3	4
2	AI32	Database Management Systems	AIML	IPCC	3	0	1	4	5
3	AI33	Data Structures	AIML	PCC	3	0	0	3	3
4	AI34	Discrete Mathematical Structures	Maths	PCC	2	1	0	3	4
5	AI35	Introduction to Artificial Intelligence	AIML	PCC	3	0	0	3	3
6	AIL36	Data Structures Laboratory	AIML	PCC	0	0	1	1	2
7	AIL37	Object Oriented Programming Laboratory	AIML	PCC	0	0	1	1	2
8	UHV38	Universal Human Values	AIML	UHV	2	0	0	2	2
9	AIAEC39	Ability Enhancement Course- III Data Engineering with Hadoop	AIML	AEC	1	0	0	1	1
Total					16	2	3	21	26
10	PE83	Physical Education		NCMC	All students have to register compulsorily for any one of the courses with the concerned coordinator (Yoga Teacher/ Physical Education Director/ NSS Coordinator) in the beginning of the III semester. Attending the registered course from III to VIII semesters and qualifying are mandatory for the award of the degree.				
	YO83	Yoga							
	NS83	NSS							
11	AM31	Additional Mathematics - I *	Maths	NCMC	0	0	0	0	3

Nomenclature: **BSC:** Basic Science Course, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **HSMC:** Humanity and Social Science & Management Courses, **AEC**–Ability Enhancement Courses, **UHV:** Universal Human Value Course, **NCMC:** Non-credit Mandatory Course

L –Lecture, T – Tutorial, P- Practical/ Drawing

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with practical of the same course. Credit for IPCC is 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 1). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated only by CIE (no SEE). However, questions from the practical part of IPCC can be included in the SEE question paper.

The Non Credit Mandatory Course, Physical Education (Sport and Athletics)/Yoga/National Service Scheme (NSS):

1. Student shall select any one of the NCMC's namely, Physical Education (Sport and Athletics)/Yoga/ NSS prescribed for VIII semesters and shall attend the course from the III semesters and upto end of VIII semesters to complete all the formalities of the course and appear for the SEE. Marks scored in SEE shall be included in the VIII semester grade card.
2. The above mentioned NCMC's shall not be considered for vertical progression as well as for the calculation of SGPA/CGPA but completion of the courses shall be mandatory for the award of degree.
3. SEE marks will be allotted by the concerned course teacher based on attendance and performance in the practice sessions/field in the ratio of 50:50. Maximum CIE marks are 50. SEE should be awarded by the course teacher every semester (III to VIII) for 50 marks and marks scored by the student are scaled down to 50 in the VIII semester.
4. The students who take a course on Physical Education and Yoga, he/she has to take up the semester end practical examination prescribed for 100 marks. The students who opt for NSS course have to submit report and attend viva-voce examination. The marks of the report shall be 50 marks and for the presentation/viva-voce 50 marks. SEE scale down to 50 marks.
5. In case, any student fails to secure the minimum 40% of the prescribed marks, he/she shall be deemed to have secured 'F' grade.

***Lateral Entry Students:**

The Non-Credit Mandatory Course, Inter/Intra Institutional Internship: All the students admitted under the lateral entry category shall have to undergo a mandatory summer Internship of 02 weeks which is an NCMC course, during the intervening vacation of the III and IV semesters. Summer Internship shall include Inter / Intra Institutional activities. A Viva-voce examination

shall be conducted during the IV semester. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of the degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete during subsequent examination after satisfying the internship requirements during subsequent semesters.

*** Lateral Entry Students:**

The Non-Credit Mandatory Course, Additional Mathematics I is prescribed for III Semester Lateral Entry Diploma students admitted to III Semester of BE Program. The student shall register for this course along with other III semester courses. The students shall attend classes for the course during the semester and complete all formalities of attendance and CIE. In case, any student fails to secure the minimum 40% of the prescribed CIE marks, he/she shall be deemed to have secured 'F' grade. In such a case, the student has to fulfill the requirements during subsequent semester/s to appear for CIE. Incase student fails to register for the said course/ falls short of attendance, he/she will repeat the course whenever it is offered next. Additional Mathematics I shall have CIE component only and no SEE component. This Course shall not be considered for vertical progression, but completion of the course shall be mandatory for the award of the degree.

AICTE Activity Points to be earned by students admitted to BE program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):

Every regular student, who is admitted to the 4-year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. Students entering 4 years degree program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students VIII semester grade card. The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled. Activity points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. Incase student fail to earn the prescribed activity points; VIII semester grade card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the VIII semester grade card.

SCHEME OF TEACHING IV SEMESTER

Sl. No.	Course Code	Course Name	Teaching Department	Category	Credits				Total contact hours /week
					L	T	P	Total	
1	AI41	Statistics and Probability for Machine Learning	Maths	BSC	2	1	0	3	4
2	AI42	Data Communication and Networking	AIML	IPCC	3	0	1	4	5
3	AI43	Design and Analysis of Algorithms	AIML	PCC	3	0	0	3	3
4	AI44	Theory of Computation	AIML	PCC	2	1	0	3	4
5	AI45	Linear programming & Queueing theory	Maths	PCC	2	1	0	3	4
6	AIL46	Algorithms Laboratory	AIML	PCC	0	0	1	1	2
7	AIL47	Statistical Programming Laboratory	AIML	PCC	0	0	1	1	2
8	AIL48	Data Modeling and Visualization Laboratory	AIML	PCC	0	0	1	1	2
9	AIAEC49	Ability Enhancement Course – IV Data Processing with SPARK	AIML	AEC	1	0	0	1	1
10	INT410	Inter/ Intra Institutional Internship	AIML	NCMC	0	0	2	2	4
				Total	13	3	6	22	31
11	AM41	Additional Mathematics II *	Maths	NCMC	0	0	0	0	-

Nomenclature: **BSC:** Basic Science Course, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **INT** –Internship, **HSMC:** Humanity and Social Science & Management Courses, **AEC**–Ability Enhancement Courses, **NCMC:** Non-credit Mandatory Course

L –Lecture, **T** – Tutorial, **P**- Practical/ Drawing

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with practical of the same course. Credit for IPCC is 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 1). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated only by CIE (no SEE). However, questions from the practical part of IPCC can be included in the SEE question paper.

*** Lateral Entry Students:**

The Non-Credit Mandatory Course, Additional Mathematics II is prescribed for IV Semester Lateral Entry Diploma students admitted to III Semester of BE Program. The student shall register for this course along with other IV semester courses. The students shall attend classes for the course during the semester and complete all formalities of attendance and CIE. In case, any student fails to secure the minimum 40% of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the requirements during subsequent semester/s to appear for CIE. Incase student fails to register for the said course/ falls short of attendance, he/she will repeat the course whenever it is offered next. Additional Mathematics II shall have CIE component only and no SEE component. This Course shall not be considered for vertical progression, but completion of the course shall be mandatory for the award of the degree.

AICTE Activity Points to be earned by students admitted to BE program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):

Every regular student, who is admitted to the 4-year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. Students entering 4 years' degree program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students VIII semester grade card. The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled. Activity points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. Incase student fail to earn the prescribed activity points; VIII semester grade card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the VIII semester grade card.

III SEMESTER

LAPLACE TRANSFORMS & VECTOR SPACE

Course Code: AI31	Credits: 2:1:0
Pre-requisites: Calculus and Basics of Linear Algebra	Contact Hours: 28L+14T
Course Coordinator: Dr. Govindaraju M V and Dr. R Suresh Babu	

Course Content

Unit I

Laplace Transforms: Definition, transforms of elementary functions, properties of Laplace transforms, existence conditions, transform of derivatives, integrals, multiplication by tn , division by t , evaluation of integrals by Laplace transforms, transform of periodic function.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation, Videos
- Links: <https://nptel.ac.in/courses/111/105/111105134/>
<https://nptel.ac.in/courses/111/105/111105035/>
Impartus recording: <https://a.impartus.com/ilc/#/course/119640/593>
<https://a.impartus.com/ilc/#/course/59742/295>

Unit II

Application of Laplace Transforms: Unit–step function, unit–impulse function. inverse transforms, convolution theorem, solution of linear differential equations and simultaneous linear differential equations using Laplace transforms, engineering applications.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/111/105/111105134/>
<https://nptel.ac.in/courses/111/105/111105035/>
Impartus recording: <https://a.impartus.com/ilc/#/course/119640/593>
<https://a.impartus.com/ilc/#/course/59742/295>

Unit III

Vector space and Linear Transformation: Vector space, linear combination and span, linearly independent and dependent vectors, basis and dimension, linear transformations, matrix of transformations, rotation about the origin, dilation, contraction and reflection, composition of matrix transformations, kernel and range, change of basis.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/111/105/111105035/>
<https://nptel.ac.in/courses/111/102/111102152/>
 Impartus recording: <https://a.impartus.com/ilc/#/course/621524/1030>
<https://a.impartus.com/ilc/#/course/619570/1030>

Unit IV

Orthogonal Projections: The null space of A, solving $Ax = 0$ and $Rx = 0$, the complete solution to $Ax = b$, dimensions of the four subspaces, orthogonality of the four subspaces, projections. orthonormal bases and Gram-Schmidt method, QR-factorization, least-squares approximations.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/111/105/111105035/>
<https://nptel.ac.in/courses/111/102/111102152/>
 Impartus recording: <https://a.impartus.com/ilc/#/course/621524/1030>
<https://a.impartus.com/ilc/#/course/619570/1030>

Unit V

Applications of Eigenvalue Decomposition: Introduction to eigenvalues and eigenvectors, similarity and diagonalization. symmetric matrices, complex matrices, Hermitian and unitary matrices, positive definite matrices, the singular value decomposition (SVD), principal component analysis (PCA), applications to linear recurrence relations, quadratic forms and conic sections.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation, Videos
- Links: <https://nptel.ac.in/courses/111/105/111105035/>
<https://nptel.ac.in/courses/111/102/111102152/>
 Impartus recording: <https://a.impartus.com/ilc/#/course/621524/1030>
<https://a.impartus.com/ilc/#/course/619570/1030>

Suggested Learning Resources

Text Books:

1. B S Grewal - Higher Engineering Mathematics - Khanna Publishers – 44th edition, 2017.
2. David C. Lay, Steven R. Lay and Judi J. Mc. Donald – Linear Algebra and its Applications, Pearson, 5th edition, 2015.
3. Gilbert Strang, Linear Algebra and its Applications, 5th Edition (2016)

Reference Books:

1. Peter V. O'Neil – Advanced Engineering Mathematics – Cengage learning, 7th edition, 2011.
2. Gareth Williams – Linear Algebra with Applications, Jones and Bartlett Press, 9th edition, 2017.
3. Erwin Kreyszig - Advanced Engineering Mathematics-Wiley-India publishers - 10th edition, 2015.

Course Outcomes (COs):

At the end of the course, students will be able to

1. Evaluate Laplace Transforms of given function and understand their properties (PO-1, 2 & PSO-2, 3)
2. Obtain inverse Laplace transforms and use it to solve system of ODE's (PO-1, 2 & PSO-2, 3)
3. Obtain matrix of linear transformation. (PO-1, 2 & PSO-2, 3)
4. Solve the system of equations by Least-Squares method. (PO-1, 2 & PSO-2, 3)
5. Obtain eigenvalue decomposition of a matrix and use it to study the concepts of SVD and PCA. (PO-1, 2 & PSO-2, 3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	Marks	Course Outcomes (COs) Addressed
Internal Test-I (CIE-I)	30	CO1, CO2, CO3
Internal Test-II CIE-II)	30	CO3, CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Quiz	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+Marks scored in Quiz+Marks scored in Assignment		
Final Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO2, CO3, CO4, CO5

DATABASE MANAGEMENT SYSTEMS	
Course Code: AI32	Credits: 3:0:1
Pre-requisites: Nil	Contact Hours: 42L+14P
Course Coordinator: Dr. Jagadish S Kallimani	

Course Content

Unit I

Introduction: Characteristics of Database approach, Actors, Workers on the scene, Data Models, schemas and instances, Three-schema architecture and data independence.

Entity- Relationship Model: Conceptual Database, A Sample Database Application, Entity types, sets, Attributes and Keys, Weak Entity Types, E-R Diagrams.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/106104135>
<https://nptel.ac.in/courses/106106220>
- Impartus Recording: <https://a.impartus.com/ilc/#/course/2137607/1174>
<https://a.impartus.com/ilc/#/course/2257777/1174>

Unit II

Relational Model and Relational Algebra: Relational Model Concepts, Constraints and Relational Database Schema, update Operations, Dealing with Constraint violations. Unary Relational Operations, Binary Relational Operations, Relational Algebra operations from Set Theory, JOIN: Natural Join and Division, Aggregate functions, Examples of Queries in Relational Algebra.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/106104135>
<https://nptel.ac.in/courses/106106220>
- Impartus Recording: <https://a.impartus.com/ilc/#/course/2137607/1174>
<https://a.impartus.com/ilc/#/course/2257777/1174>

Unit III

Introduction to SQL: Overview of the SQL Query Language, SQL Data Definition, Basic Retrieval Queries, insert, delete and update statements in SQL, Aggregate Functions, Having and Group by clauses, nested Sub-queries, Alter and Drop commands.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/106104135>
<https://nptel.ac.in/courses/106106220>
- Impartus Recording: <https://a.impartus.com/ilc/#/course/2137607/1174>
<https://a.impartus.com/ilc/#/course/2257777/1174>

Unit IV

Database Design: Informal Design Guidelines for Relation Schemas, Functional Dependencies, Normal Forms based on Primary Keys, General Definitions of Second and Third Normal Forms.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/106104135>
<https://nptel.ac.in/courses/106106220>
- Impartus Recording: <https://a.impartus.com/ilc/#/course/2137607/1174>
<https://a.impartus.com/ilc/#/course/2257777/1174>

Unit V

Transaction Management: Introduction to Transaction Processing, Transaction states, System Log and Commit Point, Desirable Properties of Transactions, Characterizing Schedules Based on Serializability, Two-Phase Locking Techniques for Concurrency Control, Dealing with Deadlock and Starvation and Detection.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/106104135>
<https://nptel.ac.in/courses/106106220>
- Impartus Recording: <https://a.impartus.com/ilc/#/course/2137607/1174>
<https://a.impartus.com/ilc/#/course/2257777/1174>

Laboratory Component:

Sl. No	Problem Statement
1. a)	Consider the Sailor database given below. The primary keys are underlined Assume relevant data types for attributes. SAILORS(<u>Sid</u> , Sname, Rating, Age) BOATS(<u>Bid</u> , Bname, Colour) RESERVES(<u>Sid</u> , <u>Bid</u> , <u>Day</u>)

	<p>Create the above tables in SQL. Specify primary and foreign keys properly. Enter at Least 5 tuples in each table with relevant data. Solve the following queries.</p> <p>Find the names of sailors who have reserved atleast one boat.</p> <p>Find the Sid's of sailors who have reserved a red or a green boat.</p> <p>Find the Sid's of sailors who have not reserved a boat.</p>
1. b)	<p>Consider the following restaurant database with the following attributes – Name, address –(building, street, area, pincode),id, cuisine, nearby landmarks, online delivery- yes/no, famous for(name of the dish)</p> <p>Create 10 documents with data relevant to the following questions. Write and execute MongoDB queries:</p> <p>List the name and address of all restaurants in Bangalore with Italian cuisine</p> <p>ii. List the name, address and nearby landmarks of all restaurants in Bangalore where north Indian thali(cuisine) is available.</p>
2. a)	<p>Consider the Employee database given below. The primary keys are underlined. Assume relevant data types for attributes.</p> <p>EMPLOYEE (Fname, Lname, <u>SSN</u>, Addr, Sex, Salary, SuperSSN, Dno)</p> <p>DEPARTMENT (Dname, Dnumber, <u>MgrSSN</u>, MgrStartDate)</p> <p>PROJECT(Pno, Pname, Dnum)</p> <p>WORKS_ON (ESSN, Pno, Hours)</p> <p>Create the above tables in SQL. Specify primary and foreign keys properly. Enter at least 5 tuples in each table with relevant data. Solve the following queries.</p> <p>Retrieve the name of all employees whose salary is greater than the salary of all employees in dept 5.</p> <p>Retrieve the SSN of all employees who work on project numbers 1,2 or 3</p> <p>Display the total Number of hours put in by all employees on every project.</p>
2. b)	<p>Consider the following restaurant table with the following attributes - Name, address –(building, street, area, pincode), id, cuisine, nearby landmarks, online delivery- (yes/no), famous for(name of the dish)</p> <p>Create 10 documents with data relevant to the following questions. Write and execute MongoDB queries:</p> <p>List the name, address and nearby landmarks of all restaurants in Bangalore where north Indian thali(cuisine) is available</p> <p>List the name and address of restaurants and also the dish the restaurant is famous for, in Bangalore.</p>

3. a)	<p>Consider the Aircraft database given below. The primary keys are underlined. Assume relevant data types for attributes.</p> <p>AIRCRAFT (<u>Aircraft ID</u>, Aircraft_name, Cruising_range) CERTIFIED (Emp ID, Aircraft ID) EMPLOYEE (Emp ID, <u>Ename</u>, Salary)</p> <p>Create the above tables in SQL. Specify primary and foreign keys properly. Enter at least 5 tuples in each table with relevant data. Solve the following queries.</p> <p>Find the employee ID's of employee who make the highest salary.</p> <p>Find the name of aircrafts such that all pilots certified to operate them earn more than 50000</p> <p>Find the employees who are not certified for operating any aircraft.</p>
3. b)	<p>Consider the following restaurant table with the following attributes - Name, address –(building, street, area, pincode), id, cuisine, nearby landmarks, online delivery- (yes/no), famous for(name of the dish)</p> <p>Create 10 documents with data relevant to the following questions. Write and execute MongoDB queries:</p> <p>List the name, address and nearby landmarks of all restaurants in Bangalore where north Indian thali(cuisine) is available.</p> <p>List the name and address of restaurants and also the dish the restaurant is famous for, in Bangalore where online delivery is available</p>
4. a)	<p>Consider the Supply-Parts database given below. The primary keys are underlined. Assume relevant data types for attributes.</p> <p>SUPPLIER (<u>Sid</u>, Sname, Address)</p> <p>PART (<u>PID</u>, Pname, Color)</p> <p>SHIPMENT (<u>Sid</u>, <u>PID</u>, Cost)</p> <p>Create the above tables in SQL. Specify primary and foreign keys properly. Enter at least 5 tuples in each table with relevant data. Solve the following queries.</p> <p>Find the Sid's of suppliers who supply a green part</p> <p>For every supplier print the name of the supplier and the total number of parts that he/she supplies</p> <p>Update the part color supplied by supplier s3 to yellow</p>
4. b)	<p>Consider the following Tourist places table with the following attributes – Place, address – (state), id, tourist attractions, best time of the year to visit, modes of transport(include nearest airport, railway station etc.), accommodation, food - what not to miss for sure</p> <p>Create 10 documents with data relevant to the following questions. Write and execute MongoDB queries:</p> <p>List all the tourist places of Karnataka</p>

	List the tourist attractions of Kerala. Exclude accommodation and food
5. a)	<p>Consider the Aircraft database given below. The primary keys are underlined. Assume relevant data types for attributes.</p> <p>AIRCRAFT (<u>Aircraft ID</u>, <u>Aircraft_name</u>, <u>Cruising_range</u>)</p> <p>CERTIFIED (<u>Emp ID</u>, <u>Aircraft ID</u>)</p> <p>EMPLOYEE (<u>Emp ID</u>, <u>Ename</u>, <u>Salary</u>)</p> <p>Create the above tables in SQL. Specify primary and foreign keys properly. Enter at least 5 tuples in each table with relevant data. Solve the following queries.</p> <p>Find the names of pilots certified for Boeing aircraft</p> <p>Arrange the Aircrafts with respect to the ascending order of distance.</p> <p>Find the name of pilots who can operate flights with a range greater than 3000 miles but are not certified on any Boeing aircraft.</p>
5. b)	<p>Consider the following Tourist places table with the following attributes – Place, address –(state, id), tourist attractions, best time of the year to visit, modes of transport(include nearest airport, railway station etc.), accommodation, food - what not to miss for sure</p> <p>Create 10 documents with data relevant to the following questions. Write and execute MongoDB queries:</p> <p>List the tourist attractions of Kerala. Exclude accommodation and food.</p> <p>List the places sorted state wise.</p>
6. a)	<p>Consider the Employee database given below. The primary keys are underlined. Assume relevant data types for attributes.</p> <p>EMPLOYEE (<u>Fname</u>, <u>Lname</u>, <u>SSN</u>, <u>Addr</u>, <u>Sex</u>, <u>Salary</u>, <u>SuperSSN</u>, <u>Dno</u>)</p> <p>DEPARTMENT (<u>Dname</u>, <u>Dnumber</u>, <u>MgrSSN</u>, <u>MgrStartDate</u>)</p> <p>DEPENDENT(<u>Dname</u>, <u>ESSN</u>)</p> <p>Create the above tables in SQL. Specify primary and foreign keys properly. Enter at least 5 tuples in each table with relevant data. Solve the following queries.</p> <p>For each department, retrieve the department name and the average salary of all employees working in that department</p> <p>List the names of managers who have at least one dependent</p> <p>Display the details of all departments having ‘tech’ as their substring</p>
6. b)	<p>Consider the following Tourist places table with the following attributes – Place, address – (state, id), tourist attractions, best time of the year to visit, modes of transport(include nearest airport, railway station etc.), accommodation, food - what not to miss for sure</p> <p>Create 10 documents with data relevant to the following questions. Write and execute MongoDB queries:</p>

	<p>List all the tourist places of Karnataka</p> <p>List the places sorted state wise</p>
7. a)	<p>Consider the following Accident Tracker Schema. The primary keys are underlined.</p> <p>PERSON (<u>driver – id #</u>, name, address)</p> <p>CAR (<u>Regno</u>, model, year)</p> <p>ACCIDENT (<u>report-number</u>, <u>acc_date</u>, location)</p> <p>OWNS (<u>driver-id #</u>, <u>Regno</u>)</p> <p>PARTICIPATED (<u>driver-id</u>, <u>Regno</u>, <u>report-number</u>, damageamount)</p> <p>Create the above tables in SQL. Specify primary and foreign keys properly. Enter at least 5 tuples in each table with relevant data. Solve the following queries.</p> <p>Display the unique Regno's of the cars involved in accidents.</p> <p>Display the car Regno and model of the car which has the maximum damage amount.</p> <p>Display the number of cars owned by each driver.</p>
7. b)	<p>Consider the following Movie table with the following attributes – Actor_name, Actor_id, Actor_birthdate, Director_name, Director_id, Director_birthdate, film_title, year of production ,type (thriller, comedy, etc.)</p> <p>Create 10 documents with data relevant to the following questions. Write and execute MongoDB queries:</p> <p>List all the movies acted by John in the year 2018</p> <p>List only the actors names and type of the movie directed by Ram</p>
8. a)	<p>Consider the Cricket database given below. The primary keys are underlined. Assume relevant data types for attributes.</p> <p>PLAYER (<u>PId</u>, Lname, Fname, Country, Yborn, Bplace)</p> <p>MATCH (<u>MatchId</u>, Team1, Team2, Ground, Date, Winner)</p> <p>BATTING (<u>MatchId</u>, <u>PId</u>, Nrums, Fours, Sixes)</p> <p>BOWLING (<u>MatchId</u>, <u>PId</u>, Novers, Maidens, Nrums, Nwickets)</p> <p>Create the above tables in SQL. Specify primary and foreign keys properly. Enter at least 5 tuples in each table with relevant data. Solve the following queries.</p> <p>Display the sorted list of ground names where Australia has played as team1</p> <p>Find the match information of all matches in which Dhoni did batting.</p> <p>Find the names of players who did batting in match 2689</p>
8. b)	<p>Consider the following shipment schema. The primary keys are underlined. Assume relevant data types for attributes.</p>

	<p>CUSTOMER (cust# ,cname, city)</p> <p>ORDER (order#, odate, cust #, ord-Amt)</p> <p>ORDER – ITEM (order #, Item #, qty)</p> <p>ITEM (item #, unit price)</p> <p>SHIPMENT (order #, ship-date)</p> <p>Create the above tables in SQL. Specify primary and foreign keys properly. Enter at least 5 tuples in each table with relevant data. Solve the following queries.</p> <p>List the customer names who have placed more than 2 orders.</p> <p>Find the total order amount for each day</p> <p>List the customer details who has the largest order amount.</p>
9. a)	<p>Consider the following shipment schema. The primary keys are underlined. Assume relevant data types for attributes.</p> <p>CUSTOMER (<u>cust#</u> ,cname, city)</p> <p>ORDER (order#, odate, cust #, ord-Amt)</p> <p>ORDER – ITEM (order #, Item #, qty)</p> <p>ITEM (item #, unit price)</p> <p>SHIPMENT (order #, ship-date)</p> <p>Create the above tables in SQL. Specify primary and foreign keys properly. Enter at least 5 tuples in each table with relevant data. Solve the following queries.</p> <p>List name of the customer, no. of orders placed by each customer residing in Bangalore city.</p> <p>List the names of the customers who have ordered at least 3 items</p> <p>List the customer names who have not ordered for item no. 10.</p>
9. b)	<p>Consider the following Movie table with the following attributes - Actor_name, Actor_id, Actor_birthdate, Director_name, Director_id, Director_birthdate, film_title, year of production, type (thriller, comedy, etc.)</p> <p>Create 10 documents with data relevant to the following questions. Write and execute MongoDB queries:</p> <p>List all the movies acted by John and Elly in the year 2012.</p> <p>List only the name and type of the movie where Ram has acted, sorted by movie names.</p>

Suggested Learning Resources

Text Book:

1. Elmasri and Navathe: Fundamentals of Database Systems, 7th Edition, Addison-Wesley, 2011.

Reference Book:

1. Silberschatz, Korth and Sudharshan, Database System Concepts, 7th Edition, Tata McGraw Hill, 2011.
2. C.J. Date, A. Kannan, S. Swaminathan, An Introduction to Database Systems, 8th Edition, Pearson education, 2009.

Course Outcomes (COs):

At the end of the course, students should be able to:

1. Design entity-relationship diagrams to represent simple database applications and convert to Relational model (PO-2, 3, 4, 5, PSO-1,3)
2. Construct relational algebraic expressions for queries using the concepts of relational database theory (PO-1, 2, 4, PSO-1,3)
3. Formulate using SQL, solutions to a broad range of query and data update problems (PO-2,3,4,5, PSO-1,3)
4. Apply Normalization to improve database design (PO-1, 2, PSO-1,3)
5. Interpret the basic issues of transaction processing, concurrency control and recovery techniques (PO-3, PO-4, PSO-1,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	Marks	Course Outcomes (COs) Addressed
Internal Test-I (CIE-I)	30	CO1, CO2
Internal Test-II (CIE-II)	30	CO3, CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Lab Test	10	CO1, CO2, CO3, CO4, CO5
Project Based Learning	10	CO1, CO2, CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Lab Test +Marks Scored in Project Based Learning		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

DATA STRUCTURES	
Course Code: AI33	Credits: 3:0:0
Pre-requisites: Basic Programming	Contact Hours: 42L
Course Coordinator: Dr. Meeradevi	

Course Content

Unit I

Basic Concepts: Pointers and Dynamic Memory Allocation, Algorithm Specification, Data Abstraction. **Arrays and Structures:** Arrays, Dynamically Allocated Arrays, Structures and Unions, Polynomials, Sparse Matrices, Strings.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/106102064>
<https://nptel.ac.in/courses/106106127>
Impartus recording: <https://a.impartus.com/ilc/#/course/82972/295>
<https://a.impartus.com/ilc/#/course/82973/295>
<https://a.impartus.com/ilc/#/course/81461/295>

Unit II

Stacks and Queues: Stacks, Stacks Using Dynamic Arrays, Queues, Circular Queues Using Dynamic Arrays, Evaluation of Expressions, Multiple Stacks and Queues.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/106102064>
<https://nptel.ac.in/courses/106106127>
Impartus recording: <https://a.impartus.com/ilc/#/course/82972/295>
<https://a.impartus.com/ilc/#/course/82973/295>
<https://a.impartus.com/ilc/#/course/81461/295>

Unit III

Linked Lists: Singly Linked lists and Chains, Representing Chains in C, Linked Stacks and Queues, Polynomials, Additional List operations, Sparse Matrices, Doubly Linked Lists.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/106102064>
<https://nptel.ac.in/courses/106106127>
 Impartus recording: <https://a.impartus.com/ilc/#/course/82972/295>
<https://a.impartus.com/ilc/#/course/82973/295>
<https://a.impartus.com/ilc/#/course/81461/295>

Unit IV

Trees: Introduction, Binary Trees, Binary Tree Traversals, Additional Binary Tree Operations, Threaded Binary Trees, Heaps, Binary Search Trees, Selection Trees, Forests, Representation of Disjoint Sets, Counting Binary Trees.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/106102064>
<https://nptel.ac.in/courses/106106127>
 Impartus recording: <https://a.impartus.com/ilc/#/course/82972/295>
<https://a.impartus.com/ilc/#/course/82973/295>
<https://a.impartus.com/ilc/#/course/81461/295>

Unit V

Graphs: The Graph Abstract Data Type, Elementary Graph Operations. Priority Queues: Single- and Double-Ended Priority Queues. Efficient Binary Search Trees: AVL Trees.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/106102064>
<https://nptel.ac.in/courses/106106127>
 Impartus recording: <https://a.impartus.com/ilc/#/course/82972/295>
<https://a.impartus.com/ilc/#/course/82973/295>
<https://a.impartus.com/ilc/#/course/81461/295>

Suggested Learning Resources

Text Book:

1. Horowitz, Sahni, Anderson-Freed: Fundamentals of Data Structures in C, 2nd Edition, Universities Press, 2008.

Reference Books:

1. Yedidyah, Augenstein, Tannenbaum: Data Structures Using C and C++, 2nd Edition, Pearson Education, 2003.
2. Data Structures, Seynour Lipschutz and GAV Pai, Schaum's Outlines, McGraw Hill, 2008.
3. Richard F. Gilberg and Behrouz A. Forouzan: Data Structures- A Pseudocode Approach with C, Cengage Learning, 2005

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Solve real time problems using concepts of dynamic memory allocation, structures, and strings. (PO-1,2,3, PSO-1,3)
2. Implement storage and retrieval of ordered data using stacks and queues as well as select appropriate data structures as applied to specified problem definition (PO-1,2,3, PSO-1,3)
3. Implement dynamic storage, retrieval and search operations of unordered data using linked list and its variants. (PO-1,2,3, PSO-1,3)
4. Implement hierarchical based solutions using different tree traversal techniques. (PO-1,2,3, PSO-1,3)
5. Develop solutions for problems based on graphs. (PO-1,2,3, PSO-1,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	Marks	Course Outcomes (COs) addressed
Internal Test-I (CIE-I)	30	CO1, CO2
Internal Test-II (CIE-II)	30	CO3, CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Project Based Learning	20	CO1, CO2, CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Project Based Learning		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3 ,CO4, CO5

DISCRETE MATHEMATICAL STRUCTURES	
Course Code: AI34	Credits: 2:1:0
Pre-requisites: Basic Mathematics	Contact Hours: 28L+14T
Course Coordinator: Dr. Govindaraju M V and Dr. S H C V Subba Bhatta	

Course Content

Unit I

Mathematical Logic: Introduction to Logic. Propositional Logic, Truth Tables, Predicates and Quantifiers, Mathematical Proofs, Mathematical induction.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/106106183>
<https://nptel.ac.in/courses/106108227>

Unit II

Relations: Properties of Binary Relations, Equivalence Relation, Partial ordering relations, Lattices, Hasse diagram, Boolean Algebra.

Recurrence Relations: Linear Recurrence Relations - Methods of solutions, solving recurrence relation by substitution, Characteristics roots solution in homogeneous Recurrence Relations.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/106106183>
<https://nptel.ac.in/courses/106108227>

Unit III

Graph Theory - I: Introduction to Graph Theory- Definitions, Sub Graphs, Walks, paths and circuits. Connected graphs, disconnected graphs and components, Euler graph, operation on graphs, Hamilton Paths and circuits, matrix representation of graphs.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/106106183>
<https://nptel.ac.in/courses/106108227>

Unit IV

Graph Theory - II: Trees, Properties of Trees, Spanning Trees, algorithm for shortest spanning tree-Kruskal, Prim's algorithm, Cut-sets, properties of cut-sets.

- Pedagogy/Course delivery tools:Chalk and talk, Power Point Presentation, Videos
- Links:<https://nptel.ac.in/courses/106106183>
<https://nptel.ac.in/courses/106108227>

Unit V

Abstract Algebra: Binary Operations, Semi Groups, Monoid, Submonoid Groups, Subgroups, properties of Groups and subgroups. Homomorphism, Isomorphism.

- Pedagogy/Course delivery tools:Chalk and talk, Power Point Presentation, Videos
- Links:<https://nptel.ac.in/courses/106106183>
<https://nptel.ac.in/courses/106108227>

Suggested Learning Resources

Text Books:

1. Kenneth Rossen, Discrete Mathematics and its Application, 7th Edition, McGraw-Hill, 2011.
2. Thomas Koshy: Discrete Mathematics with Applications. 1st Edition, Elsevier Science, 2012.
3. Narsingh Deo. Graph theory with applications to Engineering and Computer science. PHL Learning Ptv. Ltd. 2013.

Reference Books:

1. R.P. Grimaldi, B.V. Ramana, Discrete and Combinatorial Mathematics: An Applied Introduction, 5th Edition, Pearson, 2008.
2. Elements of Discrete Mathematics, C. L Liu, McGraw-Hill Inc, 1985. Applied Combinatorics, Alan Tucker, 2007.
3. Huth, M . and Ryan, M ., “ Logic in Computer Science: Modeling and Reasoning About Systems”, Cambridge University Press. 2005.
4. Douglas B. West, Introduction to Graph Theory, Second Edition, Prentice- Hall.

Course Outcomes (COs):

At the end of the course, students should be able to:

1. Write an argument using logical notation and determine if the argument is valid or invalid. (PO-1,2 & PSO-2)
2. Demonstrate an understanding of relations and be able to determine their properties and to formulate problems and solve them using recurrence relations (PO-1,2 & PSO-2)
3. Analyze different types of graphs and perform operations on graphs. (PO-1,2 & PSO-2)
4. Demonstrate knowledge of fundamental concepts in graphs using various modelling techniques. (PO-1,2, 5,10, PSO-2)
5. Demonstrate knowledge of homomorphism and isomorphism. (PO-1, 2 & PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tool	Marks	Course outcomes (CO's) addressed
Internal test-I	30	CO1, CO2, CO3
Internal test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other components	Marks	Course outcomes (CO's) addressed
Quiz	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz +Marks scored in Assignment		
Semester End Examination (SEE):		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Course Code: AI35	Credits: 3:0:0
Pre-requisites: Nil	Contact Hours: 42L
Course Coordinator: Dr. Meeradevi	

Course Content

Unit I

Introduction: What is AI?, Intelligent Agents: Agents and Environments, Rationality, The Nature of Environments, The Structure of Agents. Solving Problems by Searching: Problem-Solving Agents, Example Problems, Search Algorithms: Best-first search, Uniformed Search Strategies- Breadth-first search, Dijkstra's algorithm or uniform-cost search, Informed (Heuristic) Search Strategies- Greedy best-first search, A* search.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/106105077>
<https://nptel.ac.in/courses/106102220>

Unit II

Logical Agents: Knowledge-Based Agents, The Wumpus World, First- Order Logic: Representation Revisited, Syntax and Semantics of First-Order Logic- Models for first-order logic, Symbols and Interpretations, Atomic Sentences, Complex Sentences, The knowledge Engineering Process, Inference in First-order Logic: Propositional vs. First-Order Inference, Forward chaining, Backward chaining.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/106105077>
<https://nptel.ac.in/courses/106102220>

Unit III

Automated Planning - Definition of Classical Planning, Uncertainty: Acting under Uncertainty, Basic Probability Notations: What probabilities are about, Bayes' Rule and its Use- Applying Bayes' rule: The simple case, Naive Bayes Models- Text classification with naive Bayes. Supervised Learning, Support Vector Machines, Ensemble Learning- Random forests, Boosting.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/106105077>
<https://nptel.ac.in/courses/106102220>

Unit IV

Natural Language Processing: Language Models, Grammar, Parsing, Augmented Grammars - Semantic interpretation, Learning semantic grammars, Deep Learning for Natural Language

Processing, Recurrent Neural Networks for NLP, Pretraining and Transfer Learning- Pretrained word embeddings.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/106105077>
- <https://nptel.ac.in/courses/106102220>

Unit V

Genetic Algorithms – Representing hypotheses, Genetic Operators, Fitness Function and Selection, An Illustrative Example

Robotics- Robots, Robot Hardware, What kind of problem is robotics solving, Hardware, Reinforcement Learning in Robotics, Application Domains. Philosophy, Ethics, and Safety of AI -The Limits of AI

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/106105077>
<https://nptel.ac.in/courses/106102220>

Suggested Learning Resources

Text Books:

1. Stuart J Russel and Peter Norvig: “Artificial Intelligence - A Modern Approach”, 4th Edition, Pearson Education, 2021.
2. Tom M Mitchell, “Machine Learning”, McGraw-Hill Education (Indian Edition), 2013.

Reference Books:

1. Peter Jackson, “Introduction to Expert Systems”, 3rd Edition, Pearson Education, 2007. (Unit 5).
2. Deepak Khemani “Artificial Intelligence”, Tata Mc Graw Hill Education 2013. (unit 3).
3. <http://nptel.ac.in>

Course Outcomes (COs):

At the end of the course, the student should be able to:

1. Identify the modern view of artificial intelligence and its applications based on agent Philosophy. (PO-1,2,3,5, PSO-1,2,3)
2. Apply syntax and semantics of first order logic to solve AI problems. (PO-1,2,3,4,5,9,12, PSO-1,2,3)
3. Identify the algorithms for planning and solving problems using Bayes rule. (PO-1,4,5,6,7, PSO-1,2,3)
4. Illustrate natural language processing models using neural network algorithms. (PO-1,2,3,4,5,9, PSO-1,2,3)
5. Apply the principles of reinforcement learning techniques for robotics. (PO-1,2,3,4,5,9,10,11,12, PSO-1,2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	Marks	Course Outcomes (COs) addressed
Internal Test-I (CIE-I)	30	CO1, CO2
Internal Test-II CIE-II)	30	CO3, CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Project Based Learning	10	CO1, CO2, CO3
Report Submission	10	CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Project Based Learning +Marks scored in Report Writing		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

DATA STRUCTURES LABORATORY	
Course Code: AIL36	Credits: 0:0:1
Pre-requisites: Basic Programming	Contact Hours: 14P
Course Coordinator: Dr. Meeradevi	

Course Content

The Students are required to

1. Illustrate data operations using Pointers
2. Illustrate the concepts of malloc(), calloc(),realloc() for the dynamic allocation of memory
3. Explore different Applications by defining Structures
4. Create a stack, perform different operations such as Insert, Delete and Display
5. Create a Queue, perform different operations such as Insert, Delete and Display
6. Implement Circular Queue and to demonstrate the advantage over the linear Queue
7. Implement Multiple stacks and queues and demonstrate different operations such as Insert, Delete and Display
8. Implement the application of Doubly Linked lists
9. Create Linked List, involving Data and link field. Perform Insert, Delete operations.
10. Explore the inorder, preorder and postorder traversals techniques on Trees
11. Explore Binary Search Tree operations
12. Developing applications to solve Graph based problems like Depth First Search and Breadth First Search

Note: Each Lab Session is of two hours duration/week

Suggested Learning Resources

Text Book:

1. Horowitz, Sahni, Anderson-Freed: Fundamentals of Data Structures in C, 2nd Edition, Universities Press, 2008.

Reference Book:

1. Yedidyah, Augenstein, Tannenbaum: Data Structures Using C and C++, 2nd Edition, Pearson Education, 2003.

Course Outcomes (COs):

At the end of the course, student will be able to:

1. Develop programming solutions for real time problems using dynamic memory allocation, structures, and strings. (PO-1,2,3, PSO-2,3)
2. Develop programming solutions for real time applications using stack, Queues and linked lists (PO-1,2,3, PSO-2,3)
3. Design hierarchical based programming solutions using different tree traversal techniques and graph theory (PO-1,2,3, PSO-2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	Marks	Course Outcomes (COs) addressed
Lab Test	20	CO1, CO2, CO3
Weekly Evaluation-Lab Record	30	-
The Final CIE out of 50 Marks = Marks of Lab Record + Marks scored in Lab Test		
Semester End Examination (SEE)		
Course End Examination (One full question from the Lab Question Bank, Programs will be coded using C and executed)	50	CO1, CO2, CO3

OBJECT ORIENTED PROGRAMMING LABORATORY

Course Code: AIL37	Credits: 0:0:1
Pre-requisites: C Programming	Contact Hours: 14P
Course Coordinator: Dr. Meeradevi	

Course Content

The Students are required to

1. Understand and implement Primitive Data type and Operators
2. Illustrate the concept of Classes, objects, static variables
3. Interpret the concept of Overloading, overriding, dynamic method dispatch and its application in real-time.
4. Implement the concept of constructors and destructors
5. Interpret the concept of inheritance, interface and its application in real-time.
6. Implement the concept of Packages & abstract classes
7. Use the concept of String handling functions to perform operations on Strings
8. Understand the concept of Exception Handling mechanism to handle the runtime errors
9. Implement the concept of Multi-threading to execute the jobs in parallel
10. Implement the concept of Synchronizing the threads
11. Illustrate the concept of Event Handling to provide event classes and Listener interfaces
12. Implement the concept of Programs on Swings
13. Illustrate the concept of Lamda Expressions
14. Implement the concept of Applet

Note: Each Lab Session is of two hours duration/week

Suggested Learning Resources

Text Books:

1. Object-Oriented Analysis and Design with applications, Grady Booch, Robert A Maksimchuk, Michael W Eagle, Bobbi J Young, 3rd Edition, 2013, Pearson education, ISBN :978-81-317-2287-93.
2. The Complete Reference - Java, Herbert Schildt 10th Edition, 2017, TMH Publications, ISBN: 9789387432291.

Course Outcomes (COs):

At the end of the course, student will be able to:

1. Develop Java applications using OOP principles. (PO-2,3,5 PSO-2,3)
2. Design real world applications using multi-threading and exception handling mechanism. (PO-2,3,5 PSO-2,3)
3. Develop interactive GUI applications using Swings. (PO-2,3,5 PSO-2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	Marks	Course Outcomes (COs) addressed
Lab Test	20	CO1, CO2, CO3
Weekly Evaluation-Lab Record	30	-
The Final CIE out of 50 Marks = Marks of Lab Record + Marks scored in Lab Test+		
Semester End Examination (SEE)		
Course End Examination (One full question from the Lab Question Bank, Programs will be coded using C and executed)	50	CO1, CO2, CO3

UNIVERSAL HUMAN VALUES	
Course Code: UHV38	Credits: 2:0:0
Pre-requisites: Nil	Contact Hours: 28L
Course Coordinator: Dr. Jagadish S Kallimani	

Course Content

Unit I

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Understanding the need, basic guidelines, content and process for Value Education
2. Self-Exploration—what is it? - its content and process; ‘Natural Acceptance’ and Experiential Validation- as the mechanism for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels
 - Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
 - Lab component / Practical Topics: Survey/polls for self-exploration
 - Links: Holistic Development and Role of Education
<https://youtu.be/sGZtTPe-lhQ>

Unit II

Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’
2. Understanding the needs of Self (‘I’) and ‘Body’ - *Sukh* and *Suvidha*
3. Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer)
4. Understanding the characteristics and activities of ‘I’ and harmony in ‘I’
5. Understanding the harmony of I with the Body: *Sanyam* and *Swasthya*; correct appraisal of Physical needs, meaning of Prosperity in detail
6. Programs to ensure *Sanyam* and *Swasthya*

Practice Exercises and Case Studies will be taken up in Practice Sessions.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Lab component / Practical Topics: Survey/polls for self-exploration
- Links: Harmony in Human Being- Self and Body
<https://youtu.be/0ERSMkRPQBM>
- Links: Harmony in Human Being- Self <https://youtu.be/83oGJ4oDeIg> Links: Harmony between Self and Body Prosperity https://youtu.be/aJ_BU2OgpKs

Unit III

Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1. Understanding Harmony in the family – the basic unit of human interaction
2. Understanding values in human-human relationship; meaning of *Nyaya* and program for its fulfillment to ensure *Ubhay-tripti*;
3. Trust (*Vishwas*) and Respect (*Samman*) as the foundational values of relationship
4. Understanding the meaning of *Vishwas*; Difference between intention and competence
5. Understanding the meaning of *Samman*, Difference between respect and differentiation; the other salient values in relationship
6. Understanding the harmony in the society (society being an extension of family):
7. *Samadhan*, *Samridhi*, *Abhay*, *Sah-astitva* as comprehensive Human Goals
8. Visualizing a universal harmonious order in society- Undivided Society (*Akhand Samaj*), Universal Order (*Sarvabhaum Vyawastha*)- from family to world family!

Practice Exercises and Case Studies will be taken up in Practice Sessions.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Lab component / Practical Topics: Survey/polls for self-exploration
- Links: Harmony in Family- Trust <https://youtu.be/F2KVVW4WNnS8> Links: Harmony in family- Respect https://youtu.be/iLqNRPuv0_8
- Links: Harmony in family- Other Feeling Justice <https://youtu.be/TcYJB7reKnM> Links: Harmony in the Society <https://youtu.be/BkWgFinrnPw>

Unit IV

Understanding Harmony in the Nature and Existence - Whole existence as Co-existence

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature
3. Understanding Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all-pervasive space
4. Holistic perception of harmony at all levels of existence

Practice Exercises and Case Studies will be taken up in Practice Sessions.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Lab component / Practical Topics: Survey/polls for self-exploration
- Links: Harmony in Nature: https://youtu.be/K1Jpd_ojydw
- Links: Harmony in Existence: https://youtu.be/mormUeZ_RUE

Unit V

Implications of the above Holistic Understanding of Harmony on Professional Ethics

- Natural acceptance of human values
- Definitiveness of Ethical Human Conduct
- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
- Competence in professional ethics:
 - A. Ability to utilize the professional competence for augmenting universal human order
 - B. Ability to identify the scope and characteristics of people-friendly and eco- friendly production systems,
 - C. Ability to identify and develop appropriate technologies and management patterns for above production systems.
- Case studies of typical holistic technologies, management models and production systems
- Strategy for transition from the present state to Universal Human Order:
 - A. At the level of individual: as socially and ecologically responsible engineers, technologists and managers
 - B. At the level of society: as mutually enriching institutions and organizations

Suggested Learning Resources:

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Lab component / Practical Topics: Survey/polls for self-exploration

Text Book:

1. **R.R Gaur, R Sangal, G P Bagaria**, A foundation course in Human Values and professional Ethics, Excel books, New Delhi, 2010, ISBN 978-8-174-46781-2

Reference Books:

1. **B L Bajpai**, 2004, *Indian Ethos and Modern Management*, New Royal Book Co., Lucknow. Reprinted 2008.
2. **PL Dhar, RR Gaur**, 1990, *Science and Humanism*, Commonwealth Publishers.
3. **Sussan George**, 1976, *How the Other Half Dies*, Penguin Press. Reprinted 1986, 1991
4. **Ivan Illich**, 1974, *Energy & Equity*, The Trinity Press, Worcester, and HarperCollins, USA
5. **Donella H. Meadows, Dennis L. Meadows, Jorgen Randers**, William W. Behrens III, 1972, *limits to Growth*, Club of Rome's Report, Universe Books.
6. **Subhas Palekar**, 2000, *How to practice Natural Farming*, Pracheen(Vaidik) Krishi Tantra Shodh, Amravati.
7. **A Nagraj**, 1998, *Jeevan Vidya ek Parichay*, Divya Path Sansthan, Amarkantak.
8. **E.F. Schumacher**, 1973, *Small is Beautiful: a study of economics as if people mattered*, Blond & Briggs, Britain.
9. **A.N. Tripathy**, 2003, *Human Values*, New Age International Publishers.

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEKQw
2. <https://www.youtube.com/watch?v=P4vjfE-YnVk&list=PLWDeKF97v9SP7wSlapZcQRrT7OH0ZIGC4>
3. **Course handouts:**
https://drive.google.com/drive/folders/1zioX_4L2fCNX4Agw282PN86pcZZT3Osr?usp=sharing
4. **Presentation slides:**
https://drive.google.com/drive/folders/1rMUKh1s0HPRBlpp_b1mpS-duNRcwS6YH?usp=sharing

Course Outcomes (COs):

At the end of the course, Students will be able to:

1. Apprehend the need of Value Education over Human aspirations (PO-6)
2. Assimilate Harmony over the physical needs and to overcome the self- needs for a prosperous life. (PO-6)
3. Recognize the need of Harmony in the Family and Society for a better World. (PO-6)
4. Explain the need of mutual understanding for Holistic Harmony in all the Levels of Human Existence. (PO-6)
5. Explain the Holistic understanding of Harmony and Professional Ethics at Individual Level and Society. (PO-6, PO-8)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tool	Marks	Course outcomes addressed
Internal test-I	30	CO1, CO2, CO3
Internal test-II	30	CO3, CO4, CO5
Average of the two internal tests will be taken for 30 marks.		
Other components		
Assignment Quiz Presentation Model / mini project Any other	20 (10 + 10)	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

ABILITY ENHANCEMENT COURSE – III DATA ENGINEERING WITH HADOOP	
Course Code: AIAEC39	Credits: 1:0:0
Pre-requisites: Nil	Contact Hours: 14L
Course Coordinator: Dr. Jagadish S Kallimani	

Course Content

Unit I

Introduction to Big Data: Types, Classification and Characteristics, CAP Theorem, Basically Available Soft State Eventual Consistency (BASE).

Introduction to Hadoop: Why Hadoop? Why not RDBMS? Why Big Data and Hadoop, Hadoop Architecture, Hadoop Key Services.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos.
- Links: https://onlinecourses.nptel.ac.in/noc20_cs92/preview

Unit II

Hadoop Distributed File System(HDFS), Storage and Processing features, File read and write, Failure Scenarios, Hadoop 1 vs Hadoop 2.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos.
- Links: https://onlinecourses.nptel.ac.in/noc20_cs92/preview

Unit III

Processing Data with Hadoop: Map Reduce Features: Hadoop data types, The Mapper Class, Map method, The Reducer Class, Shuffle Phase, Sort Phase, Secondary Sort, Reduce Phase.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos.
- Links: https://onlinecourses.nptel.ac.in/noc20_cs92/preview

Unit IV

HIVE: Introduction to Hive: What is Hive? Hive Architecture, Hive Data Types, Hive File Format.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos.
- Links: <https://www.youtube.com/watch?v=xDtItNILByQ>

Unit V

Introduction to Pig: What is Pig?, The Anatomy of Pig, Pig on Hadoop, Pig Latin Overview. Data Types in Pig, Running Pig, Execution Modes, Eval Function, Relational Operators.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos.
- Links: <https://www.youtube.com/watch?v=liKhXC6NFDg>

Suggested Learning Resources

Text Book:

1. Big Data Analytics, Seema Acharya and Subhashini Chellappan. Wiley India Pvt. Ltd. 20152.

Reference:

1. Big Data Analytics: Introduction to Hadoop, Spark and Machine Learning, Raj Kamal, McGraw Hill.
2. Network Data Analytics, Siddesh G M et.al., Springer, 2018.

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Understand fundamentals of Big Data and Hadoop. (PO-2,5 & PSO-1, 3)
2. Investigate Hadoop Distributed File system. (PO-2,5 & PSO-1, 3)
3. Demonstrate the MapReduce programming model to process the big data. (PO-2, 5 & PSO-1, 3)
4. Usage of Hive platforms to manage Big data (PO-2,5 & PSO-1, 3).
5. Understand fundamentals of Pig and its features. (PO-2,5 & PSO-1, 3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	Marks	Course Outcomes (COs) addressed
Internal Test-I (CIE-I)	30	CO1, CO2, CO3
Internal Test-II (CIE-II)	30	CO3, CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Tool Demonstration	10	CO1, CO2, CO3
Report Submission	10	CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks + Marks scored in Tool Demonstration + Marks scored in Report Writing		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

PHYSICAL EDUCATION	
Course Code: PE83	Credits: NCMC
Pre-requisites: Nil	
Course Coordinator: Dr. Kiran Kumar H K	

Course Content

Course Learning Objectives:

1. To introduce students to the importance of physical fitness for success in any career.
2. To instill in them concepts of team spirit and team building
3. To develop positive thinking, goal setting and decision-making abilities under duress.
4. To harness values and skills like leadership, communication and sacrifice.
5. To inculcate in students, the ability to handle success and failures with equanimity.

Selection Process: A Student shall select any one of the following Sports based on his/her interest and the facility available. The details of **Sports Facilities available (both indoor and outdoor) at institute campus** are as below:

Outdoor Games		Indoor Games		Athletics	
Games	No. of Students	Games	No. of Students	Events	No. of Students
Volleyball	12 x 4 = 48	Badminton	30	Sprint - 100mt, 200mt, 400mt	60
Basketball	12 x 4 = 48	Table Tennis	30	Middle distance running – 800mt, 1,500mt	
Kabaddi	12 x 4 = 48	Chess	30	Long distance running – 5,000mt, 10,000mt	
Kho Kho	12 x 4 = 48	Weight Training [Gym]	35	Jumping Events – Long Jump Triple Jump High Jump	30
Throw ball	12 x 4 = 48			Throwing Events Shot Put Discuss Javelin	30
Football	16 x 4 = 64	Note: Students should bring their own sports attires			
Hockey	16 x 4 = 64				
Cricket	16 x 4 = 64				

Contact Sessions: A student shall abide by the following during the sessions scheduled in the semester.

Session 1

Fundamentals of Physical Education, value addition to personality through fitness education, discipline and team building activities, Orientation towards particular sports and skill training

Session 2

Formation of teams based on student's orientation and preference. Team practice and skill enhancement.

Session 3

Conduction of matches in all sporting events registered by Students. Evaluation of each student shall be based on their performance either in team or individual. The student representing the Institute at University/State/National/International Level will be awarded additional marks during evaluation.

Course Outcomes (COs):

1. Develop interest and skill in playing particular sports.
2. Understand the process of organizing sporting events.
3. Appreciate the role of fitness for a better lifestyle.
4. Derive lessons from sports activities for effective planning and discipline in Life.
5. Analyze situations and optimize end results.

Course Assessment & Evaluation:

1. A committee consisting of Sports Director and Coaches of respective Sports will be formed to observe and evaluate the students for CIE in each semester.
2. Students shall follow the schedules, rules and regulations as prescribed by the Committee.
3. Students shall mandatorily have 85% attendance to be eligible for evaluation.
4. All the Sessions and evaluation process will be common for all semesters of the academic year.
5. The final result will be reflected on the grade card of 8th Semester.
6. The final marks shall be calculated after scaling down CIE to 50 marks & combining with 50 marks for SEE.

YOGA	
Course Code: YO83	Credits: NCMC
Pre-requisites: Nil	
Course Coordinator: Dr. Hari Chandra B P & Dr. Parimala P	

Course Learning Objectives:

1. To introduce to the students, the fundamental theoretical aspects of yoga.
2. To inculcate in students a habit of practicing yoga.
3. To be able to demonstrate basic yoga asanas.
4. To be able to practice fundamental breathing practices and mudras.
5. To understand the relevance of yoga and research in modern times.

Course Content

Introduction: Definition of yoga, benefits, astangas of yoga, Relevance of yoga and yoga-research in modern times.

Asanas: Kriyathmakachalanas, Suryanamaskar, Superbrain yoga, Vrikshasana, Trikonasana, Veerabhadrasana, Paschimotanasana, Purvotanasana, Bharadwajasana, Amruthasana, Parivruttha Trikonasana, Parsvakonasana, Ustrasana, Padmasana, Jaaanushirshasana, Navasana, Ardhaachakrasana, Ardhaakathichakrasana, Jataraparivarthanasana, Sethubandasana, Sarvangasana, Mathyasana, Dhanurasana, Shirshasana.

Pranayamas: Anuloma-Viloma, Suryanuloma, Chandranuloma, Brahmari, Suryanbedhana, Chandrabedhana, Sheetali, Seethkari, Sadantha, bastrika.

Mudras: Chinmudra-Jnanamudra, Praana mudra, panchaprana mudras, panchabhoota mudras, Pruthvi mudra, Shoonya mudra, Surya mudra, Jalodharanashaka mudra, Kundalini mudra, shoonyavaayu mudra, shakti mudra, sandhi mudra, vajra mudra and garuda mudra.

Course Outcomes (COs):

At the end of the course, a student will

1. Understand the fundamental and theoretical aspects of yoga.
2. Develop a habit of practicing yoga.
3. Demonstrate basic yoga asanas.
4. Demonstrate fundamental breathing practices.
5. Understand the relevance of yoga and its research in modern times.

Reference Books:

1. Light on yoga, B K S Iyengar, Publisher -Thorsons, UK, 2006
2. Light on pranayama, B K S Iyengar, Publisher - Element; First Edition
3. The Essential Yoga Mudras for Healing, Dr. Aasoori K. Rangaraja Iyengar, Saranga Publishing; First Edition 2021

Pedagogy:

- Chalk and talk, demonstration, videos, ppt.

Contact Sessions:

- There would be one introduction class, and five contact classes in each semester.
- The candidates shall practice yoga on a daily basis, or in the worst case on alternate days at their place of residence and maintain a short diary in the format provided by yoga teacher. The same shall be brought to the classes.

Online reference sources:

- Yoga for beginners part 1: <https://www.youtube.com/watch?v=VwPeThpwfWI>
- Yoga for beginners part 2: https://www.youtube.com/watch?v=s_pnJTcOp8A
- Suryanamaskar: <https://www.youtube.com/watch?v=nUdlucNd6go&t=133s>
- Yoga for anxiety and stress: https://www.youtube.com/watch?v=hJbRpHZr_d0
- Common yoga protocol: https://www.youtube.com/watch?v=Av5ib_XRKT4
- Relevance of yoga in modern times:
www.youtube.com/watch?v=HUzBCts7BT0

Course Assessment & Evaluation:

1. A committee consisting of Yoga Instructors will be formed to observe and evaluate the students for CIE in each semester.
2. Students shall follow the schedules, rules, and regulations as prescribed by the Committee.
3. Students shall mandatorily have 85% attendance to be eligible for evaluation.
4. All the Sessions and evaluation processes will be common for all semesters of the academic year.
5. The final result will be reflected on the grade card of 8th Semester.
6. The final marks shall be calculated after scaling down CIE to 50 marks & combining it with 50 marks for SEE.

Scheme of SEE

Practical Demonstration	30 marks
Write-up	10 marks
Viva	10 marks
Total	50 marks

NATIONAL SERVICE SCHEME	
Course Code: NS83	Credits: NCMC
Pre-requisites: Nil	
Course Coordinator: Dr. Puttabore Gowda & Dr. Siddaraju C	

Course Learning Objectives:

1. To introduce students to the importance of national service
2. To harness values and skills like leadership, teamwork and sacrifice.
3. To serve society through educational services and health
4. To work towards rural and local development through technological services
5. To inculcate in students, the ability to handle socially relevant projects.

Students shall involve in activities related to national and regional technical and non-technical services, as listed below.

- Serving society by bringing awareness on education and cleanliness.
- Blood donation camps
- Developing technologies for rural masses.
- Conduction and participation in camps for a social cause.
- Educating towards health and well-being of individuals/society.
- Cultural and educational programs for society.
- Contributing towards the improvement of civil services and bringing certain shortcomings to the notice of higher authorities for suitable remedial actions.
- Contribution towards traffic management and other public services.
- Clean up and development of water sources around public places.
- Services during a disaster or other needy situations.
- Camps for the rejuvenation of lakes and water bodies.
- Serving nature and agriculture.
- Awareness programs on health and food adulteration.
- Presenting papers/talks in various fora on the above topics.
- Developing technologies for rural masses beyond academic requirements.
- Plantation programs.
- Conducting programs for self-sustainability, and human and national development.
- Contribution towards orphans and challenged individuals through well-recognized organizations.
- Carrying out designated activities in villages.

- Development and implementation of strategies for solid waste, E-waste etc.
- Education towards pollution control and traffic management.
- Production of documentaries and short films/videos for motivating people on any of the above causes.

Course Outcomes (COs):

At the end of the course, a student will be able to

1. Understand the importance of national service.
2. Gain skills like leadership and teamwork.
3. Volunteer towards educational services and health.
4. Contribute to rural and local development through technical services.
5. Comprehend socially relevant projects

Contact Sessions:

- The students shall attend the review and contact sessions as scheduled by the course coordinator.

Course Assessment & Evaluation:

1. The candidates shall maintain a record of activities in a Diary, and get them endorsed during the contact sessions at least 3 times in a semester.
2. A detailed project report should be submitted during the last fortnight of the semester
3. Evaluation will be done during each semester based on the nature of the contribution.
4. The final marks shall be calculated after scaling down CIE to 50 marks & combining with 50 marks for SEE

ADDITIONAL MATHEMATICS – I	
Course Code: AM31	Credits: 0:0:0
Prerequisites: Nil	Contact Hours: 42L
Course Coordinator: Dr. Shashi Prabha Gogate S	

Course Content

Unit I

Differential Calculus: Successive differentiation, nth derivatives of some standard functions, Leibnitz theorem, Polar curves. Angle between the radius vector and the tangent, angle between curves, length of the perpendicular from pole to the tangent, pedal equations. Taylor's and Maclaurin's expansions.

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: <https://nptel.ac.in/courses/111/105/111105121/>
<https://nptel.ac.in/courses/111/104/111104144/>
- Impartus recording: <https://a.impartus.com/ilc/#/course/107625/1030>

Unit II

Integral Calculus: Introduction, Reduction formula, Reduction formula for $\sin^n x dx$ integrals. $\int \cos^n x dx$ and $\int \sin^n x \cos^m x dx$. Evaluation of double and triple

Pedagogy/Course delivery tools: Chalk and Talk

- Links: <https://nptel.ac.in/courses/111/105/111105121/>
- <https://a.impartus.com/ilc/#/course/107625/1030>

Unit III

Vector Algebra: Scalar and vectors. Vector addition and subtraction. Multiplication of vectors (Dot and Cross products). Scalar and vector triple product-simple problems. Vector functions of a single variable. Derivative of a vector function, geometrical interpretation. Velocity and acceleration.

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: <https://nptel.ac.in/courses/111/105/111105134>
- Impartus recording: <https://a.impartus.com/ilc/#/course/107625/1030>

Unit IV

Vector Differentiation: Scalar and vector fields, gradient of a scalar field, directional derivative, divergence of a vector field, solenoidal vector, curl of a vector field, irrotational vector. Laplace's operator. Vector identities connected with gradient, divergence and curl.

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: <https://nptel.ac.in/courses/111/105/111105134>
- Impartus recording: <https://a.impartus.com/ilc/#/course/107625/1030>

Unit V

First Order Differential Equations: Solution of first order and first-degree differential equations, variable separable methods, homogeneous equations, linear and Bernoulli's equations, exact differential equations.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation
- Links: <https://nptel.ac.in/courses/111/105/111105121/>
- Impartus recording: <https://a.impartus.com/ilc/#/course/59742/295>

Text Books:

1. **B.S. Grewal** – Higher Engineering Mathematics, Khanna Publishers, 44th edition, 2017.
2. **Erwin Kreyszig** – Advanced Engineering Mathematics – Wiley Publication, 10th Edition, 2015.

Reference Books:

1. **H. K. Dass** – Higher Engineering Mathematics – S Chand Publications, 1998.
2. **B. V. Ramana** – Engineering Mathematics – Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2008.

Course Outcomes (COs):

At the end of the course the student will be able to

1. Solve problems related to nth derivative to some standard functions, polar curves and power series expansions.
2. Apply the concept of reduction formula to determine the length, area, volume of revolution of an arc of the curve.
3. Solve the problems related to velocity and acceleration.
4. Apply vector differentiation to identify solenoidal and irrotational vectors.
5. Apply the concept of various methods to solve first order first degree differential equations.

IV SEMESTER

STATISTICS AND PROBABILITY FOR MACHINE LEARNING	
Course Code: AI41	Credits: 2:1:0
Prerequisites: Basic Probability	Contact Hours: 28L+14T
Course Coordinator: Dr. S H C V SUBBA BHATTA	

Course Content

Unit I

Statistics: Curve fitting by the method of least squares, fitting linear, quadratic and geometric curves, correlation, Rank correlation.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation, Videos
- Links: https://onlinecourses.nptel.ac.in/noc23_ma50/preview

Unit II

Regression Analysis: Linear regression, Multiple correlation and regression, Partial correlation and regression, ridge regression, logistic regression, Review of probability, Probability interpretation of correlation and regression.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://onlinecourses.nptel.ac.in/noc23_ma50/preview

Unit III

Probability Distributions I: Random variables, Binomial distribution, Poisson distribution.

Uniform distribution, Exponential distribution, Gamma distribution and Normal distribution.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/117105085>
- <http://nitttrc.edu.in/nptel/courses/video/111105041/L19.html>

Unit IV

Probability Distributions II: Lognormal distribution, Central limit theorem, Relation between Binomial and Normal distribution, Relation between Poisson and Normal distribution. **Joint probability distribution:** Joint probability distribution (both discrete and continuous), conditional probability, conditional expectation.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://www.nptelvideos.com/course.php?id=746>

Unit V

Sampling and Statistical Inference: Sampling distributions, concepts of standard error and confidence interval, level of significance, type I and type II errors, one tailed and two tailed tests, Z-test: for single mean, for single proportion and for difference between means, Student's t-test: for single mean and for difference between two means, F-test for equality of two variances, Chi-square test: for goodness of fit and for independence of attributes.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation, Videos
- Links: <http://www.nitttrc.edu.in/nptel/courses/video/111105041/L23.html>

Suggested Learning Resources

Text Books:

1. R.E. Walpole, R. H. Myers, R. S. L. Myers and K. Ye – Probability and Statistics for Engineers and Scientists – Pearson Education – Delhi – 9th edition – 2012.
2. T. Veerarajan- Probability, Statistics and Random processes – Tata McGraw-Hill Education – 3rd edition -2017.
3. Johnson/Miller: Miller & Freund's Probability and Statistics for Engineers, Ninth Edition, Pearson Education India -2018.

Reference Books:

1. Sheldon M. Ross – Probability models for Computer Science – Academic Press, 10th edition Elsevier– 2010.
2. Murray R Spiegel, John Schiller & R. Alu Srinivasan – Probability and Statistics – Schaum's outlines -4th edition-2012.
3. Kishore S. Trivedi – Probability & Statistics with Reliability, Queuing and Computer Science Applications – John Wiley & Sons – 2nd edition – 2008.
4. Dirk P. Kroese, Zdravko I. Botev, Thomas Taimre, Radislav Vaisman, Data Science and Machine Learning, Mathematical and Statistical Methods, Chapman and Hall/CRC, 2019.

Course Outcomes (COs):

At the end of the course, students will be able to

1. Apply method of least squares to find the curve of best fit for the given data. (PO-1, 2 & PSO-1,2)
2. Understand the differences between simple and multiple linear regression. (PO-1, 2 & PSO-1,2)
3. Analyze the given random data and its probability distributions. (PO-1, 2 & PSO-1,2).
4. Find parameters of Continuous Probability distributions and calculate the marginal and conditional distributions of bivariate random variables. (PO-1, 2 & PSO-1,2).
5. Choose an appropriate test of significance and make inference about the population from a sample. (PO-1, 2 & PSO-1,2).

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	Marks	Course outcomes addressed
Internal test-I	30	CO1, CO2, CO3
Internal test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other components	Marks	Course outcomes addressed
Quiz	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

DATA COMMUNICATION AND NETWORKING	
Course Code: AI42	Credits: 3:0:1
Prerequisites: Basic Concepts of Electrical and Electronics	Contact Hours: 42L+14P
Course Coordinator: Dr. Meeradevi A K	

Course Content

Unit I

Data communication Fundamentals: Introduction, components, Data Representation, Data Flow; Networks – Network criteria, Physical Structures, Network Models, Categories of networks; Protocols, Standards, Standards organization. **Network Models** -Layered tasks; The OSI model – Layered architecture; Layers in the OSI model; TCP/IP Protocol suite; Addressing.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/106105082>
- Lab Component / Practical Topics : Wireshark Exercise on HTTP
- Impartus Recording: <https://a.impartus.com/ilc/#/course/96149/452>

Unit II

Digital Transmission Fundamentals: Analog & Digital data, Analog & Digital signals (basics); Transmission Impairment – Attenuation, Distortion and Noise; Data rate limits – Nyquist Bit Rate, Shannon Capacity. **Digital Transmission:** Digital-to-Digital conversion - Line coding, Line coding schemes (unipolar, polar, bipolar); Analog-to-Digital conversion - PCM.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/106105082>
- Lab Component / Practical Topics : Socket Programming
- Impartus Recording: <https://a.impartus.com/ilc/#/course/96149/452>

Unit III

Error detection & correction: Cyclic codes – CRC, Polynomials, Checksum.

Network layer: Logical addressing - IPv4 addresses, Address space, notations, classful and classless addressing with problem solving, NAT, IPv6 addresses; IPv6 addresses; Network layer: Internet protocol - IPv4 datagram, fragmentation, checksum and options; IPv6 packet format, advantages and extension headers; Transition from IPv4 to IPv6.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://onlinecourses.nptel.ac.in/noc22_ee61/preview
- Lab Component / Practical Topics : Wireshark Exercise on IP, ICMP, DHCP
- Impartus Recording: <https://a.impartus.com/ilc/#/course/96149/452>

Unit IV

Network layer: Delivery, Forwarding, & Routing –Forwarding Techniques, Forwarding Process, Routing Table; Unicast routing protocols – Optimization, Intra and Inter domain routing, distance vector routing, link state routing, path vector routing.

Transport Layer - Process-to-Process delivery, User Datagram Protocol, Transmission Control Protocol.

- Pedagogy /Course delivery tools: Chalk and talk, Power point presentation, Videos
- Link : https://onlinecourses.nptel.ac.in/noc22_ee61/preview
- Lab Component / Practical Topics : Error detection and correction using CRC and Hamming Code
- Impartus Recording: <https://a.impartus.com/ilc/#/course/96149/452>

Unit V

Congestion control - Congestion, Congestion control, congestion control in TCP.

Application Layer: Domain Name System - Namespace, Domain name space, Distribution of Name space, DNS in internet, Resolution; Remote logging – TELNET; Electronic mail – Architecture, User Agent, Message Transfer Agent: SMTP; File transfer - File transfer protocol (FTP);

1. Pedagogy /Course delivery tools: Chalk and talk, Power point presentation, Videos
2. Link : https://onlinecourses.nptel.ac.in/noc22_ee61/preview
3. Lab Component / Practical Topics : Multiplexing concepts
4. Impartus Recording: <https://a.impartus.com/ilc/#/course/96149/452>

Laboratory Component:

No.	Topics Covered
1.	Wireshark tool demo.
2.	Trace Hypertext Transfer Protocol using packet sniffer and packet analyser.
3.	Trace Domain Name Server using packet sniffer and packet analyser.
4.	Trace File Transfer Protocol using packet sniffer and packet analyser.
5.	Trace Internet Control Message Protocol using packet sniffer and packet analyser
6.	Trace Dynamic Host Configuration Protocol using packet sniffer and packet analyser.
7.	Write a program for error detection using CRC-CCITT(16-bits).
8.	Write a program for error detection and correction using hamming code.
9.	Write a program to find the shortest path between vertices using bellman-ford algorithm.
10.	Write a program to find the shortest path between vertices using link Dijkstra algorithm.
11.	Write a program for congestion control using leaky bucket algorithm.
12.	Using TCP/IP sockets, write a client – server program where the client send the file name and the server send back the contents of the requested file if present.
13.	Design an RPC (Remote Procedure Call) application for a server performing integer arithmetic operations. Describe call and reply message contents, error handling, and client-server interaction.
14.	Design and implementation of a peer-to-peer application for performing basic Addition and displaying the contents of files shared among peers.

Suggested Learning Resources**Text Book:**

1. Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition, Tata McGraw-Hill Education, 2013.

Reference Books:

- Introduction to Data Communications and Networking – Wayne Tomasi, Pearson Education, 2005.
- Larry L. Peterson and Bruce S Davie: Computer Networks: A Systems Approach, Fifth Edition, Elsevier, 2011.
- Tanenbaum: Computer Networks, 4th Ed, Pearson Education/PHI, 2003.
- James F. Kurose and Keith W. Ross: Computer Networking: A Top- Down Approach, 6th edition, Addison-Wesley, 2013.

Course Outcomes (COs):

At the end of the course, the students will be able to:

1. Differentiate between different types of network topologies and data transmission techniques. (PO-1, 2, 3, 4, 10, PSO-1, 2).
2. Illustrate sliding window and access control protocols of data link layer (PO-1, 2, 3, 4, 10, PSO-1, 2).
3. Solve problems of IP addressing and routing using various routing protocols and algorithms. (PO-1, 2, 3, 4, 10, PSO1,2).
4. Differentiate between connection oriented and connection less services of transport layer (PO-1, 2, 3, 4,10, PSO1,2).
5. Describe the various application layer protocols used by TCP/IP reference mode (PO-1, 2, 3, 4, 10, PSO1, 2).

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	Marks	Course Outcomes addressed
Internal Test-I (CIE-I)	30	CO1, CO2
Internal Test-II CIE-II)	30	CO3, CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Lab Test	10	CO1, CO2, CO3, CO4, CO5
Tool Demonstration	10	CO1, CO2, CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Lab Test +Marks scored for Tool Demo		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

DESIGN AND ANALYSIS OF ALGORITHMS	
Course Code: AI43	Credits: 3:0:0
Prerequisites: Basic Programming	Contact Hours: 42L
Course Coordinator: Megha J	

Course Content

Unit I

Asymptotic Bounds and Representation problems of Algorithms: Computational Tractability: Some Initial Attempts at Defining Efficiency, Worst-Case Running Times and Brute-Force Search, Polynomial Time as a Definition of Efficiency, Asymptotic Order of Growth: Properties of Asymptotic Growth Rates, Asymptotic Bounds for Some Common Functions, A Survey of Common Running Times: Linear Time, $O(n \log n)$ Time, Quadratic Time, Cubic Time, $O(n^k)$ Time, Beyond Polynomial Time, Sub linear Time. Some Representative Problems, A First Problem: Stable Matching: The Problem, Designing the Algorithm, Analysing the Algorithm, Extensions, Implementing the Stable Matching Algorithm, Using Lists and Arrays: Arrays and Lists, Five Representative Problems: Interval Scheduling, Weighted Interval Scheduling, Bipartite Matching, Independent Set, Competitive Facility Location.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/106101060>
<https://nptel.ac.in/courses/106106131>
- Impartus recording: <https://a.impartus.com/ilc/#/course/270253/452>

Unit II

Graphs & Divide and Conquer: Graph Connectivity and Graph Traversal, Breadth- First Search: Exploring a Connected Component, Depth-First Search, Implementing Graph Traversal Using Queues and Stacks: Implementing Breadth-First Search, Implementing Depth-First Search, An Application of Breadth-First Search: The Problem, Designing the Algorithm, Directed Acyclic Graphs and Topological Ordering: The Problem, Designing and Analyzing the Algorithm, A First Recurrence: The Merge sort Algorithm: Unrolling the Merge sort Recurrence, Counting Inversions: The Problem, Designing and Analyzing the Algorithm.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos Links: <https://nptel.ac.in/courses/106101060>
<https://nptel.ac.in/courses/106106131>
- Impartus recording: <https://a.impartus.com/ilc/#/course/270253/452>

Unit III

Greedy Algorithms: Interval Scheduling: The Greedy Algorithm Stays Ahead: Designing a Greedy Algorithm, Analyzing the Algorithm, Scheduling to Minimize Lateness: An Exchange Argument: The Problem, Designing the Algorithm, Optimal Caching: A More Complex Exchange Argument: The Problem, Designing and Analyzing the Algorithm, Extensions: Caching under Real Operating Conditions, Shortest Paths in a Graph: The Problem, Designing the Algorithm, Analyzing the Algorithm, The Minimum Spanning Tree Problem: The Problem, Designing Algorithms, Analyzing the Algorithms, Huffman Codes and Data Compression: The Problem, Designing the Algorithm.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/106101060>
<https://nptel.ac.in/courses/106106131>
- Impartus recording: <https://a.impartus.com/ilc/#/course/270253/452>

Unit IV

Dynamic Programming: Weighted Interval Scheduling: A Recursive Procedure: Designing a Recursive Algorithm, Subset Sums and Knapsacks: Adding a Variable: The Problem, Designing the Algorithm, Shortest Paths in a Graph: The Problem, Designing the Algorithm, The Maximum-Flow Problem and the Ford-Fulkerson Algorithm: The problem, Designing the Algorithm, Survey Design: The problem, Designing the Algorithm, Analyzing the Algorithm, Airline Scheduling: The problem, Designing the Algorithm, Analyzing the Algorithm.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/106101060>
<https://nptel.ac.in/courses/106106131>
- Impartus recording: <https://a.impartus.com/ilc/#/course/270253/452>

Unit V

NP and Computational Intractability: Polynomial-Time Reductions A First Reduction: Independent Set and Vertex Cover, Reducing to a More General Case: Vertex Cover to Set Cover, NP-Complete Problems: Circuit Satisfiability: A First NP-Complete Problem, General Strategy for Proving New Problems NP- Complete, Sequencing Problems: The Traveling Salesman Problem, The Hamiltonian Cycle Problem.

Suggested Learning Resources

Text Book:

1. Algorithm Design - Jon Kleinberg and Eva Tardos, Pearson, 1st Edition (2013).

Reference Book:

1. Introduction to the Design & Analysis of Algorithms - Anany Levitin, 2nd Edition, Pearson Education, 2007.

Course Outcomes (COs):

At the end of the course, the student will be able to:

1. Define the basic concepts and analyse worst-case running times of algorithms using asymptotic analysis. (PO-1,2, PSO-1,3)
2. Recognize the design techniques for graph traversal using representative algorithms. (PO-1,2,3, PSO-1,3)
3. Identify how divide and conquer works and analyse complexity of divide and conquer methods by solving recurrence. (PO-1,2,3, PSO-1,3)
4. Illustrate Greedy paradigm and Dynamic programming paradigm using representative algorithms. (PO-1,2,3,4, PSO-2,3)
5. Describe the classes P, NP, and NP-Complete and be able to prove that a certain problem is NP-Complete. (PO-1,2,3,4, PSO-2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	Marks	Course Outcomes addressed
Internal Test-I (CIE-I)	30	CO1, CO2, CO3
Internal Test-II (CIE-II)	30	CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Project Based Learning	10	CO1, CO2, CO3
Report Submission	10	CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Project Based Learning +Marks scored in Report Writing		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

THEORY OF COMPUTATION	
Course Code: AI44	Credits: 2:1:0
Prerequisites: Basic Mathematics	Contact Hours: 28L+ 14T
Course Coordinator: Dr. Jagadish S Kallimani	

Course Content

Unit I

Introduction to Finite Automata, structural representations, automata and complexity, the central concepts of automata theory, deterministic finite automata, nondeterministic finite automata, an application of finite automata, finite automata with epsilon transitions.

- Pedagogy/Course delivery tools : Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/106104148>
<https://nptel.ac.in/courses/106104028>
- Impartus recording: <https://a.impartus.com/ilc/#/course/81462/295>

Unit II

Regular expressions, finite automata and regular expressions, applications of regular expressions, proving languages not to be regular, closure properties of regular languages, equivalence and minimization of automata.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/106104148>
<https://nptel.ac.in/courses/106104028>
- Impartus recording: <https://a.impartus.com/ilc/#/course/81462/295>

Unit III

Context—free grammars, parse trees, applications, ambiguity in grammars and languages, definition of the pushdown automata, the languages of a PDA,

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/106104148>
<https://nptel.ac.in/courses/106104028>
- Impartus recording: <https://a.impartus.com/ilc/#/course/81462/295>

Unit IV

Deterministic Pushdown Automata, normal forms for CFGs, the pumping lemma for CFGs, Intersection of CFL and Regular Language.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/106104148>
<https://nptel.ac.in/courses/106104028>
- Impartus recording: <https://a.impartus.com/ilc/#/course/81462/295>

Unit V

The Turing machine, Extensions to the basic Turing machine, Turing machine and computers, Undecidability: An Undecidable Problem that is RE, Definition of Post's Correspondence problem.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/106104148>
<https://nptel.ac.in/courses/106104028>
- Impartus recording: <https://a.impartus.com/ilc/#/course/81462/295>

Suggested Learning Resources

Text Book:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman: Introduction to Automata Theory, Languages and Computation, 3rd Edition, Pearson Education, 2011.

Reference Books:

1. John C Martin: Introduction to Languages and Automata Theory, 3rd Edition, Tata McGraw-Hill, 2007.
2. Michael Sipser: Introduction to the Theory of Computation, 3rd Edition,
3. Thompson Course Technology, Boston, MA and Cengage Learning India Pvt. Ltd., 2014.

Course Outcomes (COs):

At the end of the course, the student will be able to:

1. Explain the basic concepts of formal languages and finite automata. (PO-1, PSO-1)
2. Construct automata to accept strings from a specified language. (PO-1,2,3, PSO-1)
3. Convert among equivalently powerful notations for a language, including among DFAs, NFAs, and regular expressions, between PDAs, CFGs and normal forms of CFGs. (PO-1,2,3, PSO-1)
4. Prove the various closure and decision properties of formal languages. (PO-1,2, PSO-1)
5. Explain the concepts of Undecidability, RE languages and Post Correspondence problem. (PO-1,2, PSO-1,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	Marks	Course Outcomes addressed
Internal Test-I (CIE-I)	30	CO1, CO2, CO3
Internal Test-II CIE-II)	30	CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Quiz -I	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz-I +Marks scored in Assignment		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

LINEAR PROGRAMMING & QUEUEING THEORY	
Course Code: AI45	Credits: 2:1:0
Prerequisites: Basic Probability	Contact Hours: 28L+14T
Course Coordinators: Dr. S. H. C. V. Subba Bhatta	

Course Content

Unit I

Linear Programming I: Introduction to Linear Programming Problem (LPP), Formulation of the problem, Graphical method, General, Canonical and standard forms of LPP, Simplex method, Big-M method, Two-phase simplex method.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/112106134>

Unit II

Linear Programming II: Duality in linear programming, Fundamental theorem of Duality, Dual simplex method. Transportation problem, Finding initial basic feasible solution by North-West corner method, Vogel's approximation method, Test for optimality – MODI method, Assignment problem – Hungarian method.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/112106134>

Unit III

Sequencing Problem: Introduction, problem of sequencing, Basic terms, Processing n jobs through 2 machines, processing n jobs through 3 machines.

Network Scheduling: Introduction, Network and Basic components, Logical sequencing, Rules of Network construction, Critical Path Analysis, Probability considerations in PERT, Distinction between PERT and CPM.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://nptel.ac.in/courses/112106134>

Unit IV

Markov Chain: Introduction to stochastic process, probability vectors, stochastic matrices, regular stochastic matrices, Markov chains, higher transition probabilities, stationary distribution of regular Markov chains and absorbing states,

Markov processes: Chapman -Kolmogorov equations, Mean time spent in transient states. Applications—Models for Algorithmic efficiency, The Gambler's ruin problem. Poisson process- Counting process, Inter arrival and waiting time distributions, continuous time Markov chain, Birth and death process.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://archive.nptel.ac.in/courses/111/103/111103158/>

Unit V

Queuing theory: Introduction, symbolic representation of a queuing model, single server Poisson queuing model with infinite capacity ($M/M/1 : /FIFO$), single server Poisson queuing model with finite capacity ($M/M/S : N/FIFO$), multiple server Poisson queuing model with infinite capacity ($M/M/S : /FIFO$), Multiple server Poisson queuing model with finite capacity ($M/M/S : N/FIFO$), introduction to $M/G/1$ queuing model.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://archive.nptel.ac.in/courses/111/103/111103159/>

Text Books:

1. Kanti Swarup, P.K. Gupta and Man Mohan -Operations Research-Sultan Chand & Sons Publishers–2014.
2. R.E. Walpole, R. H. Myers, R. S. L. Myers and K. Ye – Probability and Statistics for Engineers and Scientists – Pearson Education – Delhi – 9th edition – 2012.
3. Sheldon M. Ross – Probability models for Computer Science – Academic Press, Elsevier– 2009.

Reference Books:

1. J. K. Sharma - Operations research - Theory and Applications –Trinity- 6th edition- 2016.
2. Kishore S. Trivedi – Probability & Statistics with Reliability, Queuing and Computer Science Applications – John Wiley & Sons – 2nd edition – 2008
3. T. Veerarajan- Probability, Statistics and Random processes – Tata McGraw-Hill Education – 3rd edition -2017.

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Formulate and solve LPP by using Graphical, Simplex and Big-M method. (PO-1, 2 & PSO-1, 2)
2. Solve transportation and assignment models. (PO-1, 2 & PSO-1, 2)
4. Formulate and solve mathematical model for sequencing and management problems using LPP concepts. (PO-1, 2 & PSO-1, 2)
5. Predict future events using Markov chain and Markov process. (PO-1, 2 & PSO-1, 2)
6. Understand the basic characteristic features of a queuing system and acquire skills in analyzing queuing models (PO-1, 2 & PSO-1, 2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	Marks	Course outcomes addressed
Internal test-I	30	CO1, CO2, CO3
Internal test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other components	Marks	Course outcomes addressed
Quiz	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz +Marks scored in Assignment		
Semester End Examination (SEE):		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

ALGORITHMS LABORATORY	
Course Code: AIL46	Credits: 0:0:1
Prerequisites: Basic C Programming	Contact Hours: 14P
Course Coordinator: Megha J	

Course Content

The Students are required to

1. Illustrate the concepts of Asymptotic bounds and functions to understand the concept of Time Complexity
2. Explore Sorting techniques like Insertion and Selection Sort.
3. Understand Stable matching using Gale Shapley Algorithm by giving the Preference list.
4. Demonstrate Graph traversal techniques such as Breadth First Search and Depth First Search
5. Implement Merge Sort to demonstrate the Divide and Conquer Technique
6. Implement Partition Algorithm and Quick Sort technique
7. Implement Kruskal, Prims and Dijkstra's to find the Minimal Spanning Tree.
8. Demonstrate Optimal Interval Scheduling using Greedy Technique.
9. Demonstrate Dynamic Programming Techniques like Ford Fulkerson and Knapsack.
10. Implement Branch and Bound Techniques like Traveling Salesman.

Suggested Learning Resources

Reference Books:

1. Algorithm Design - Jon Kleinberg and Eva Tardos, Tsinghua University Press (2005).
2. Anany Levitin: Introduction to the Design & Analysis of Algorithms, 2nd Edition, Pearson Education, 2007.

Course Outcomes (COs):

At the end of the course, the student will be able to:

1. Define the basic concepts and analyze worst-case running times of algorithms using asymptotic analysis. (PO-1,4,10, PSO-1,2)
2. Recognize the design techniques for graph traversal, divide and conquer, greedy and dynamic programming paradigm using representative algorithms. (PO-1,2,3, 5, 7, 9, 10, PSO-1,2,3)
3. Illustrate Branch and bound paradigm through NP complete problems. (PO-1, 3, 4, 10,12, PSO-2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	Marks	Course Outcomes addressed
Lab Test	20	CO1, CO2, CO3
Weekly Evaluation-Lab Record	30	-
The Final CIE out of 50 Marks = Marks of Lab Record + Marks scored in Lab Test		
Semester End Examination (SEE)		
Course End Examination (One full question from the Lab Question Bank, Programs will be coded using C and executed)	50	CO1, CO2, CO3

STATISTICAL PROGRAMMING LABORATORY	
Course Code: AIL47	Credits: 0:0:1
Prerequisites: Basic Programming	Contact Hours: 14P
Course Coordinator: Dr. Meeradevi	

Course Content

The students are required to

1. Understand and Interpret the basic concepts, Syntaxes in R
2. Demonstrate the vector data objects operations
3. Implement the concept of matrix, array and factors
4. Demonstrate the usage of data frames in statistical analysis.
5. Demonstrate the creation of sample (Dummy) Data and perform data manipulation
6. Study and implementation of various control structures in R
7. Demonstrate data manipulation operation with dplyr and data.table package
8. Study and implementation of Data Visualization with ggplot2
9. Study and implementation data transpose operations in Statistical analysis.
10. Demonstrate Descriptive statistics in R
11. Implementing Statistical operations, T-test, Paired Test,
12. Implementing Statistical analysis like correlation, Chi Square test, Analysis of Variance and Correlation.

Suggested Learning Resources

Reference Books:

1. An Introduction to Statistical Programming Methods with R, Matthew Beckman, Stéphane Guerrier, Justin Lee, Roberto Molinari, Samuel Orso & Iegor Rudnytskyi, <https://smac-group.github.io/ds/>, 2020
2. Norman Matloff, The Art of R Programming, UC Davis 2009.
3. Michael Akritas, " Probability & Statistics with R for Engineers and Scientists", 2nd Edition on, CRC Press, 2016.
4. Crawley, M. J. (2006), "Statistics - An introduction using R", John Wiley, London 32.
5. "Statistical Programming in R", Oxford University Press, 2016

Course Outcomes (COs):

At the end of the course the student will be able to:

- Demonstrate the basic concepts of R, use of Data frames and various control structures (PO1,2,3,4,5,12, PSO1,2 and 3)
- Illustrate Data Manipulation and Visualization (PO1,2,3,4,5, 12, PSO1,2 and 3)
- Appraise different statistical operations. (PO1,2,3,4,5,12,PSO1,2 and 3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	Marks	Course Outcomes addressed
Lab Test	20	CO1, CO2, CO3
Weekly Evaluation-Lab Record	30	-
The Final CIE out of 50 Marks = Marks of Lab Record + Marks scored in Lab Test		
Semester End Examination (SEE)		
Course End Examination (One full question from the Lab Question Bank, Programs will be coded using C and executed)	50	CO1, CO2, CO3

DATA MODELING AND VISUALIZATION LABORATORY

Course Code: AIL48	Credits: 0:0:1
Prerequisites: Basic Programming	Contact Hours: 14P
Course Coordinator: Dr. Amruthesh S M	

Course Content

1. Demonstrate the Python programming with: simple and complex data types, operators, flow control, string manipulation and functions-
2. Implement the solution for recognizing pattern with and without using regular expressions
3. Demonstrate the operation on files: Read, Write and Organize.
4. Working with classes and familiarity with object-oriented programming concepts.
5. Working on object attributes: identity, type, and value.
6. Implementing objects and its functionalities: Iteration, object creation, object destruction, collections, attribute access, etc.
7. Demonstration of working with excel spreadsheets and web scraping
8. Demonstration of working on data set using pandas library: read_csv, describe, head, loc[:,value_counts,drop_duplicates,fillna.
9. Implement dataset's distribution with a histogram and Categorical Data analysis with bar plots and their ratios with pie plots using
10. Demonstrate working with line and scatter plots on a data set to explore the relationship between two attributes and visualize correlation between them.

Suggested Learning Resources

Text Books:

1. Al Sweigart, "Automate the Boring Stuff with Python", 1st Edition, No Starch Press, 2015. (Available under CC-BY-NC-SA license at <https://automatetheboringstuff.com/>)
2. Reema Thareja "Python Programming Using Problem Solving Approach" Oxford University Press.
3. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2015. (Available under CC-BY-NC license at <http://greenteapress.com/thinkpython2/thinkpython2.pdf>)

Course Outcomes (COs):

1. Demonstrate proficiency in handling of loops and creation of functions.
2. Identify the methods to create and manipulate lists, tuples and dictionaries.
3. Discover the commonly used operations involving regular expressions and file system, Interpret the concepts of Object-Oriented Programming as used in Python, and Determine the need for scraping websites and working with PDF, JSON and other file formats.

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	Marks	Course Outcomes addressed
Lab Test	20	CO1, CO2, CO3
Weekly Evaluation-Lab Record	30	-
The Final CIE out of 50 Marks = Marks of Lab Record + Marks scored in Lab Test		
Semester End Examination (SEE)		
Course End Examination (One full question from the Lab Question Bank, Programs will be coded using C and executed)	50	CO1, CO2, CO3

ABILITY ENHANCEMENT COURSE – IV	
DATA PROCESSING WITH SPARK	
Course Code: AIAEC49	Credits: 1:0:0
Prerequisites: Nil	Contact Hours: 14L
Course Coordinator: Dr. Jagadish S Kallimani	

Course Content

Unit I

Overview of Spark: What Is Apache Spark?, Apache Spark's Philosophy, Context: The Big Data Problem, History of Spark, The Present and Future of Spark, Running Spark

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos.
- Links: <https://www.youtube.com/watch?v=9U4ED7KQwIE>

Unit II

Spark's Basic Architecture, Spark Applications, Spark's Language APIs, Spark's APIs, Starting Spark, The SparkSession, An End-to-End Example.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos.
- Links: <https://www.youtube.com/watch?v=9U4ED7KQwIE>

Unit III

Resilient Distributed Datasets (RDDs): About RDDs, Types of RDDs, When to Use RDDs?, Datasets and RDDs of Case Classes, Creating RDDs, Transformations.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://spark.apache.org/docs/latest/rdd-programming-guide.html>

Unit IV

Spark SQL: Big Data and SQL: Spark SQL, Spark's Relationship to Hive, How to Run Spark SQL Queries, Spark SQL CLI, Tables, Spark-Managed Tables, Creating Tables, Inserting into Tables, Select Statement.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: <https://www.youtube.com/watch?v=M40WQzjGePw>

Unit V

Streaming: What Is Stream Processing?, Stream Processing Use Cases, Advantages of Stream Processing, Challenges of Stream Processing, Stream Processing Design Points.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Link: <https://www.youtube.com/watch?v=UuRhEmqqhRM>

Suggested Learning Resources

Text Book:

1. Spark in Action: Jean-Georges Perrin, Manning Publications.

Reference:

1. Big Data Analytics: Introduction to Hadoop, Spark and Machine Learning, Raj Kamal, McGraw Hill.
2. Apache Spark for Data Science: Cook Book, Padma Priya, Packt. Publishers.

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Understanding of Apache Spark and the Spark Ecosystem. (PO-2,5 & PSO-1, 3)
2. Understanding Spark Architecture and execution. (PO-2, 5 & PSO-1, 3)
3. Usage of Resilient Distributed Datasets in Spark. (PO-2,5 & PSO-1, 3)
4. Usage of Spark SQL to process the data. (PO-2,5 & PSO-1, 3)
5. Applying Spark Streaming techniques for computing streaming data in real time. (PO-2,5 & PSO-1, 3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	Marks	Course Outcomes addressed
Internal Test-I (CIE-I)	30	CO1, CO2, CO3
Internal Test-II CIE-II)	30	CO3, CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Tool Demonstration	10	CO1, CO2, CO3, CO4, CO5
Report Submission	10	CO1,CO2,CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30Marks + Marks scored Tool Demo +Marks scored Report Writing		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

ADDITIONAL MATHEMATICS - II	
Course Code: AM41	Credits: 0:0:0
Prerequisites: Nil	Contact Hours: 42
Course Coordinator: Dr. Veena B N	

Course Content

Unit I

Differential Calculus- I: Partial differentiation, Euler's theorem, total differential coefficient, differentiation of composite and implicit functions.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: <https://nptel.ac.in/courses/111/105/111105121/>
Impartus recording: <https://a.impartus.com/ilc/#/course/107625/1030>

Unit II

Differential Calculus- II: Jacobian and Properties. Taylor's theorem for function of two variables, maxima and minima for functions of two variables.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: <https://nptel.ac.in/courses/111/105/111105121/>
Impartus recording: <https://a.impartus.com/ilc/#/course/107625/1030>
<https://a.impartus.com/ilc/#/course/59742/295>

Unit III

Vector Integration: Line integrals, surface integrals and volume integrals. Green's theorem, Stokes' and Gauss divergence theorem (without proof) and problems, orthogonal curvilinear coordinates.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: <https://nptel.ac.in/courses/111/105/111105134/>
Impartus recording: <https://a.impartus.com/ilc/#/course/619570/1030>

Unit IV

Higher Order Differential Equations: Higher order linear differential equations, method of variation of parameters, Cauchy's and Legendre's homogeneous differential equations.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: <https://nptel.ac.in/courses/111/105/111105121/>
Impartus recording: <https://a.impartus.com/ilc/#/course/96127/452>
<https://a.impartus.com/ilc/#/course/59742/295>

Unit V

Probability: Introduction. Sample space and events. Axioms of probability. Addition and multiplication theorems. Conditional probability- illustrative examples. Bayes theorem – examples.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: <https://nptel.ac.in/courses/111/107/111107119/>
<https://nptel.ac.in/courses/111/107/111107119/>
Impartus recording: <https://a.impartus.com/ilc/#/course/283623/703>

Text Books:

1. **B.S. Grewal** – Higher Engineering Mathematics, Khanna Publishers, 44th edition, 2017.
2. **Erwin Kreyszig** – Advanced Engineering Mathematics – Wiley Publication, 10th Edition, 2015.

Reference Books:

1. **H. K. Dass** – Higher Engineering Mathematics – S Chand Publications, 1998
2. **V. Ramana** – Engineering Mathematics – Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2008.

Course Outcomes (COs):

At the end of the course the student will be able to

1. To carryout differentiation of function of several variables.
2. Solve the problems related to Jacobians, the extreme values of a function and Taylors series.
3. Exhibit the interdependence of line, surface and volume integrals using integral theorems.
4. Find the solution of second and higher order ODEs with constant and variable coefficients.
5. Solve the problems on conditional probability and Baye's theorem.

Inter/ Intra Institutional Internship	
Course Code: INT410	Credits: 0:0:2
Pre – requisites: Nil	Contact Hours: 04
Course Coordinator: Artificial Intelligence and Machine Learning Faculty	

Course Content

Students are required to carry out training in an Artificial Intelligence and Machine Learning industry or research organization or with a start-up or firm super specialty hospital for not less than four weeks after 4th or during 5th semester. The internship addresses innovation/societal contributions or should evolve a student's entrepreneurial skill sets. Students are required to submit a report on the same in the format provided by the internship committee at the department. The students will be evaluated by the training committee based on the rubrics informed to students by the committee.

Course Outcomes (COs):

On successful completion of this course, students will be able to:

1. Analyze the functional aspects of Artificial Intelligence and Machine Learning (PO-2,4,7,11,12, PSO-1,2,3)
2. Enhance the communication skills to work in interdisciplinary teams in industry/organization. (PO-9, 10, PSO-2,3)
3. Realize the professional and ethical responsibility. (PO-6, 7, 8, PSO-2, 3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	Marks	Course Outcomes (COs) addressed
Phase-I Evaluation	20	CO1, CO2, CO3
Phase-II Evaluation	30	CO1, CO2, CO3
The Final CIE out of 50 Marks : Addition of the Marks Scored in Phase-I + Marks Scored in Phase-II marks		