RAMAIAH
Institute of Technology

CURRICULUM

Outcome Based Education
(Academic Year 2022 – 2023)

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 15 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 is 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 65% 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. **M S 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. MSRIT is a member of DELNET, CMTI and VTU E-Library Consortium. MSRIT has a modern auditorium 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, M S Ramaiah Institute of Technology has achieved 67th rank among 1249 top Engineering Institutions & 17th Rank for School of Architecture in India for the year 2022 and is 1st amongst the Engineering Colleges affiliated to VTU, Karnataka.

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

- Imparting quality technical education by nurturing a conducive learning environment through continuous improvement and customization
- Establishing research clusters in emerging areas in collaboration with globally reputed organizations
- 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

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	Linear Algebra & Laplace Transforms	Maths	BSC	2	1	0	3	4
2	AI32	Database Systems	AIML	IPCC	2	0	1	3	4
3	AI33	Data Structures	AIML	PCC	3	0	0	3	3
4	AI34	Discrete Mathematical Structures	Maths	PCC	2	1	0	3	3
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	HS391	Kannada (Kali / Manasu)	Humanities	HSMC	1	0	0	1	1
10	AEC310	Ability Enhancement Course- III	--	AEC	1	0	0	1	1
				Total				**21**	**25**
11	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. Qualifying is mandatory for the award of the degree.				
	YO83	Yoga							
	NS83	NSS							
12	AM31	Additional Mathematics - I *	Maths	NCMC	0	0	0	0	3

NOTE: Branches: CSE, AI & ML, AI & DS, CSE(CS), CSE (AI & ML), ISE, ECE: Kannada (Kali / Manasu) in III Semester
Constitution of India & Professional Ethics in IV Sem

Branches: EEE, MLE, ETE, EIE, ME, CV, IEM, CH, BT: Constitution of India & Professional Ethics in III Semester
Kannada (Kali / Manasu) in IV Semester

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 03 and its Teaching–Learning hours (L : T : P) can be considered as (2 : 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.

HS39/ HS49 Kannada Manasu is for students who speak, read and write Kannada and
HS39/ HS49 Kannada Kali is for non-Kannada speaking, reading, and writing students.

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, 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.

Inter/Intra Institutional Internship: All the students admitted under lateral entry category shall have to undergo a mandatory summer Internship-I of 03 weeks during the intervening vacation of III and IV semesters. Summer Internship shall include Inter / Intra Institutional activities. A Viva-voce examination shall be conducted during IV semester and the prescribed credit shall be included in IV semester after students clearing this head. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of 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:

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	Numerical Techniques and Probability Models	Maths	BSC	2	1	0	3	4
2	AI42	Data Communication and Networking	AIML	IPCC	2	0	1	3	4
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	3
5	AI45	Introduction to Machine Learning	AIML	PCC	3	0	0	3	3
6	AIL46	Algorithms Laboratory	AIML	PCC	0	0	1	1	2
7	AIL47	Machine Learning Laboratory	AIML	PCC	0	0	1	1	2
8	AIL48	Python Programming Laboratory	AIML	PCC	0	0	1	1	2
9	HS492	Constitution of India & Professional Ethics	Humanities	HSMC	1	0	0	1	1
10	AEC410	Ability Enhancement Course – IV	--	AEC	1	0	0	1	1
11	INT411	Inter/ Intra Institutional Internship	AIML	INT	0	0	2	2	-
				Total				**22**	**25**
12	AM41	Additional Mathematics II *	Maths	NCMC	0	0	0	0	-

NOTE: Branches: CSE, AI & ML, AI & DS, CSE(CS), CSE (AI & ML), ISE, ECE: Kannada (Kali / Manasu) in III Semester Constitution of India & Professional Ethics in IV Sem **Branches: EEE, MLE, ETE, EIE, ME, CV, IEM, CH, BT:** Constitution of India & Professional Ethics in III Semester Kannada (Kali / Manasu) in IV Semester
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 03 and its Teaching–Learning hours (L : T : P) can be considered as (2 : 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.
HS39/ HS49 Kannada Manasu is for students who speak, read and write Kannada and **HS39/ HS49 Kannada Kali** is for non-Kannada speaking, reading, and writing students.
Innovation/ Societal/ Entrepreneurship based Internship: At the End of fourth Semester four - weeks summer internship shall be carried out at industry, State and Central Govt./NGO/MSME, Innovation centre's or incubation centres. The internship can be Rural Internship. All the students shall have to undergo mandatory internship of 04 weeks during the intervening period of IV & V semesters. A Viva-Voce examination (CIE) shall be conducted during V semester and the prescribed credit shall be included in VI semester. Internship shall be considered as a head of passing and shall be considered for the award of 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. The in-charge faculty has to monitor the student's internship progress and interact to guide them for the successful completion of the internship. Innovation/ Societal/ Entrepreneurship based Internship shall have only CIE no SEE component.
*** <u>Lateral Entry Students:</u>** **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 fulfil the

requirements during subsequent semester/s to appear for CIE. In case 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. In case 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

LINEAR ALGEBRA & LAPLACE TRANSFORMS	
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	

Unit I

Laplace Transforms: Definition, transforms of elementary functions, properties of Laplace transforms, existence conditions, transform of derivatives, integrals, multiplication by t^n, division by t, evaluation of integrals by Laplace transforms. Transform of Periodic function.

- 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 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

Linear Transformation: Linear combination and span, Linearly independent and dependent vectors, Basis and Dimension, Linear transformations, Composition of matrix transformations, Rotation about the origin, Dilation, Contraction and Reflection, 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

Vector Space: Vector Spaces, 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, Markov Chains, Quadratic Forms and Conic Sections.

- 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

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 -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

DATABASE SYSTEMS	
Course Code: AI32	**Credits:** 2:0:1
Pre – requisites: Nil	**Contact Hours:** 28L+14P
Course Coordinator: Megha J	

Unit I

Introduction: Characteristics of Database approach, Actors on the Scene, Workers behind the scene, Advantages of using DBMS approach, Data models, schemas a nd instances, Three-schema architecture and data independence, Database languages and interfaces, the database system environment, Entity-Relationship Model: Conceptual Database using high level Conceptual data models for Database Design, A Sample Database Application, Entity types, Entity sets Attributes and Keys Relationship types, Relationship Sets, Roles and Structural Constraints Weak Entity Types.

- 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, Relational Model Concepts, Relational Model Constraints and Relational Database Schema Update Operations, Transactions and Dealing with Constraint violations, Unary Relational operations, Relational Algebra Operations from Set Theory, Binary Relational Operations, JOIN and DIVISION, Additional Relational Operations, Examples of Queries in Relational Algebra Relational Database Design Using ER- to-Relational Mapping.

- 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 structure of SQL Queries, Additional Basic Operations, Null values, Aggregate Functions, nested Sub queries, Modification of the Database, Join Expressions, Views.

- 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 2nd Database Systems 14 and 3rd Normal Forms, Boyce Codd 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: Transaction Concept, a Simple Transaction Model, Transaction Atomicity and Durability, Serializability, Concurrency Control: Lock-Based Protocols, Deadlock Handling, Recovery System.

- 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

Suggested Learning Resources

Text Books:

1. Elmasri and Navathe: Fundamentals of Database Systems, 5th Edition, Addison-Wesley, 2011.
2. Silberschatz, Korth and Sudharshan, Data base System Concepts, 6th Edition, Tata McGraw Hill, 2011.

Reference Book:

1. C.J. Date, A. Kannan, S. Swamynatham, 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
Lab Project	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 Lab Project		
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. Sowmya B J	

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, Representation of Multidimensional Arrays, 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, Leftist Trees. 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		
Programming Competition/ Hackathon/Codethon	20	CO1, CO2, CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in other component		
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	

Unit I

Fundamentals of Logic and Set Theory: Introduction to Logic. Propositional Logic, Truth Tables, and Quantifiers, Mathematical Proofs. Infinite Sets, Well-Ordering. Countable and Uncountable Sets, Cantor's Diagonalization. Mathematical Induction - Weak and Strong 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 and Functions: Relations, Equivalence Relations. Functions, Bijections. Binary Relations. Boolean Algebra, Posets and Lattices, Hasse Diagrams.

- 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

Recurrence Relations: Counting, Sum and Product rule, Principle of Inclusion Exclusion. Pigeon Hole Principle, Counting by Bijections. Double Counting. Linear Recurrence Relations - Methods of solutions. Generating Functions. Permutations and Counting.

- 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: Introduction to Graph Theory- Definitions, Sub Graphs, Complements, and Graph Isomorphism, Euler's Trails and Circuits, Hamilton Paths and Cycles. Planar Graphs, Euler's Theorem, Graph Coloring.

- 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, Isomorphism, Homomorphism, Euler's phi function, Fermat's Little theorem.

- 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. B. Kolman, R.C. Busby, S.C. Ross, Discrete Mathematical Structures, Pearson Education India; 6th edition, 2015.

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-1,2,4, PSO-2,3)
2. Demonstrate an understanding of relations and be able to determine their properties. (PO-1,2,4,5,10, PSO-2)
3. To formulate problems and solve them using recurrence relations. (PO-1,4,5,10, 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, 5, 10, PSO-2)

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		
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 A K	

Unit I

Introduction: What is AI? The Foundation of Artificial Intelligence. 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, Searching for Solution, Uniformed Search Strategies- Breadth-first search, Dijkstra's algorithm or uniform-cost search, Depth-first search and the problem of memory, Comparing uninformed search algorithms, 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, Interference 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, Algorithms for Classical Planning, Backward search for planning Heuristics for Planning, Uncertainty: Acting under Uncertainty, Basic Probability Notations, Bayes' Rule and its Use- Applying Bayes' rule: The simple case, Naive Bayes Models- Text classification with naive Bayes. Supervised Learning, Learning Decision Trees, 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, Pretrained contextual representations.

- 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.
3. Elaine Rich, Kevin Knight, Shivashankar B Nair: Artificial Intelligence, 3rd Edition, Tata McGraw Hill, 2011.

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).

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 intelligent agents for Artificial Intelligence programming techniques. (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		
Quiz	10	CO1, CO2, CO3
Assignment	10	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

DATA STRUCTURES LABORATORY	
Course Code: AIL36	**Credits:** 0:0:1
Pre – requisites: Basic Programming	**Contact Hours:** 14P
Course Coordinator: Dr. Sowmya B J	

Course Content

Sl. No.	Topics Covered
1.	Illustrating Pointers for data operations
2.	Examining Dynamic memory allocations
3.	Managing Structures in applications
4.	Organizing Stacks in programs
5.	Constructing Queues for applications
6.	Implement circular queues
7.	Implement Multiple stacks and queues
8.	Usage of doubly linked list in applications
9.	Setting up Linked lists for data set operations
10.	Binary Tree traversals
11.	Graphs representation and traversals
12.	Developing applications to solve Graph based problems

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-I	10	CO1, CO2
Lab Test-II	10	CO3
Weekly Evaluation-Lab Record	30	-
The Final CIE out of 50 Marks = Marks of Lab Record + Marks scored in Lab Test-I + Marks scored in Lab Test-II		
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: Vinay T R	

Course Content

1. Primitive Data type and Operators
2. Control Statements and Arrays
3. Classes, objects, static variables
4. Overloading, overriding, dynamic method dispatch
5. Inheritance, interface
6. Packages & abstract classes
7. String handling
8. Exception Handling
9. Multi-threading
10. Synchronizing the threads
11. Event Handling
12. Programs on Swings
13. Lamda Expressions
14. Collection Frameworks

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-I	10	CO1, CO2
Lab Test-II	10	CO3
Weekly Evaluation-Lab Record	30	-
The Final CIE out of 50 Marks = Marks of Lab Record + Marks scored in Lab Test-I + Marks scored in Lab Test-II		
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:** 42L
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!

- Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
- Understanding the needs of Self ('I') and 'Body' - *Sukh* and *Suvidha*
- Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
- Understanding the characteristics and activities of 'I' and harmony in 'I'
- Understanding the harmony of I with the Body: *Sanyam* and *Swasthya*; correct appraisal of Physical needs, meaning of Prosperity in detail
- 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/F2KVW4WNnS8
  Links: Harmony in family- Respecthttps://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 Books:

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=PLWDeKF97v9SP7wSlapZcQRrT7OH0ZlGC4
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)		
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

KANNADA KALI	
Course Code: HS391K	**Credits:** 1:0:0
Pre – requisites: Nil	**Contact Hours:** 14L
Course Coordinator: Mrs. Kanya Kumari S	

Unit I

(Parichaya) - Introduction

Kannada Bhashe - About Kannada Language, Eight Kannada Authors – JnanpiTh Awardies

Introduction to Kannada Language, Karnataka State and Literature.

- Pedagogy/Course delivery tools: Chalk and Talk, power point presentation

Unit II

naamapadagaLu – Sarva namapadagaLu – (Nouns -Pronouns) and it's usage in Kannada

Kannada namavisheshanagaLu - (Adjectives-Interrogatives)

kriyapadagaLu,kriya visheshaNagaLu- (verb-adverb)

Sambhashaneyalli Prashnarthaka padagalu –vaakyagaLu mattu kriyapadagaLu-visheshaNagaLu (Kannada- Interrogative words & Sentences and verb-adverb in Conversation)

- Pedagogy/Course delivery tools: Chalk and Talk, power point presentation

Unit III

Samanya Sambhashaneyalli Kannadada Padagalu mattu Vaakyagalu

(Kannada Words and Sentences in General Conversation with activities)

sambhashaNe: (Conversation with Friends- Teachers, between Friends)

(Conversation in Shop, Hostel, Market, Bus and Train)

Shabdakosha: Vocabulary – chaTuvaTike: Exercises

Vicharaneya / Bedikeya vakyagalu(Enquiry /Request sentences in Conversation)

Sambhashane Conversation with House Owner and Room mate

Shabdakosha – Vocabulary - Exercises to test their knowledge of understanding the Language.

- Pedagogy/Course delivery tools: Chalk and Talk, power point presentation

Unit IV

Kannada padagaLu (eakavachana,bahuvachanagaLu,virudda padagaLu dina nityadalli baLasuva padagaLu mattu sankya vyavaste

Sambhashaneyalli Eakavachana mattu Bhahuvachana- (Singular and Plural nouns) Conversation- Sambhashaneyalli Linga rupagaLu- Genders in Conversation

Viruddha padagalu /Virodarthaka padagalu (Antonyms) Asamanjasa Uchcharane (Inappropriate Pronunciation)

Sankhya Vyavasthe(Numbers system) -Samaya /Kalakke Sambhandhisida padhagalu (Words Relating to time) – Dikkugalige sambhadisida padhagalu (Words Relating to Directions)

Aaharakke sambandisida padagaLu(Names connected with food)

Manavana shareerada bhagagalu / Angagalu (Parts of the Human body) Manava Sambhandhada da padhagalu (Terms Relating to Human Relationship)

Manavana Bhavanegalige sambandisida Padagalu (Words Relating to Human's feelings and Emotions)

Vaasada staLakke sambhandisidanthaha padhagalu (Words Relating to place of leaving)

- Pedagogy/Course delivery tools: Chalk and Talk, power point presentation

Unit V

Kannada akshara maale (Kannada alphabets and their practices with pronunciations)

swara aksharagaLu –vyanjanaksharagaLu- gunitaksharagaLu, tantragnana mattu AaDalita padagaLu-Technical and administrative worlds in Kannada

- Pedagogy/Course delivery tools: Chalk and Talk, power point presentation

Text Book:

1. Dr. L. Thimmesh, Prof. Keshava muurthy, 'BaLake kannada' prasarangaa, VTU,2020.

Reference Book:

1. Smt. Kanya Kumari.S – 'Kannada Kali' Kinnari publications' First edition, Bengaluru,2022
2. Lingadevaru Halemane – 'Kannada Kali', Prasaranga kannada University Hampi, 6rd Edition. 2019

Course out comes (COs):

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

1. Develop vocabulary (PO-10)
2. Identify the basic Kannada language skill (PO-10)
3. Develop listing & speaking skill in Kannada language. (PO-6, PO-12)
4. Enrich language skill. (PO-12)
5. Apply Kannada language skill for various purpose (PO-12)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 marks		
Assessment tool	**Marks**	**Course outcome attained**
Internal test-1	30	CO1, CO2, CO3
Internal test-1I	30	CO4, CO5
Avarege of the Two Internal Test Two will be Taken for 30 Marks		
Other components		
Assignment	10	CO1, CO2
quiz	10	CO3, CO4, CO5
Semester end examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

ಕನ್ನಡ ಮನಸು	
Course Code: HS391M	**Credits:** 1:0:0
Pre – requisites: Nil	**Contact Hours:** 14L
Program: B.E(Common to all the Branches)	**Semester:** IV
Course Coordinator: Mrs. Kanya Kumari S	

ಘಟಕ – 1 (Unit I)

ಲೇಖನಗಳು (Articles)– ಕಾವ್ಯಭಾಗ **(poetry)**

ಕನ್ನಡ ಭಾಷೆ ನಾಡು – ನುಡಿ

ಕರ್ನಾಟಕ ಸಂಸ್ಕೃತಿ

ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ

ವಚನಗಳು–ಅಕ್ಕಮಹಾದೇವಿ–ಬಸವಣ್ಣ–ಅಲ್ಲಮಪ್ರಭು

- Pedagogy/Course delivery tools: Ch Chalk and Talk, power point presentation

ಘಟಕ – 2 (Unit II)

ಕೀರ್ತನೆ ಮತ್ತು ತತ್ವ ಪದಗಳು

ಪುರಂದರ ದಾಸರು ಮತ್ತು ಕನಕದಾಸರ ಪದಗಳು

ಶಿಶುನಾಳ ಶರೀಫರು ಮಹಾಂತ ಶಿವಯೋಗಿಗಳ ಪದಗಳು

ಜನಪದ ಗೀತೆ

- Pedagogy/Course delivery tools: Ch Chalk and Talk, power point presentation

ಘಟಕ – 3 (Unit III)

ಆಧುನಿಕ ಕಾವ್ಯಗಳು

ಮಂಕುತಿಮ್ಮನ ಕಗ್ಗ

ಕುರುಡು ಕಾಂಚಾಣ

ಚೋಮನ ಮಕ್ಕಳ ಹಾಡು

Pedagogy/Course delivery tools: Ch Chalk and Talk, power point presentation

ಘಟಕ –4 (Unit IV)

ತಾಂತ್ರಿಕ ಧುರೀಣರು(ವ್ಯಕ್ತಿ ಪರಿಚಯ) ಕಥೆ–ಪ್ರವಾಸ ಕಥನ

ಡಾ.ಸರ್.ಎಂ.ವಿಶ್ವೇಸ್ವರಯ್ಯ– ವ್ಯಕ್ತಿ ಮತ್ತು ಐತಿಹ್ಯ – ಎ,ಎನ್.ಮೂರ್ತಿರಾಯರು

ಯುಗಾದಿ –ವಸುಧೇಂದ್ರ

ಮೆಗಾನೆ ಎಂಬ ಗಿರಿಜನ ಪರ್ವತ –ಹಿ.ಚಿ.ಬೋರಲಿಂಗಯ್ಯ

- Pedagogy/Course delivery tools: Ch Chalk and Talk, power point presentation

ಘಟಕ– ೫ (Unit V)

ಕರಕುಶಲ ಕಲೆಗಳು –ತಾಂತ್ರಿಕ ವಿಜ್ಞಾನ **(technical science)**

ಕರಕುಶಲ ಕಲೆಗಳು –ಮತ್ತು ಪರಂಪರೆ ವಿಜ್ಞಾನ– ಕರಿಗೌಡ ಬೇಚನ ಹಳ್ಳಿ

ಕಂಪ್ಯೂಟರ್ ಹಾಗು ಮಾಹಿತಿ ತಂತ್ರಜ್ಞಾನ–

ಕ'ಮತ್ತು **ಬ** ಬರಹ ತಂತ್ರಾಂಶಗಳು ಮತ್ತು .ಕಂಪ್ಯೂಟರ್ ಮುಖಾಂತರ ಕನ್ನಡ ಟೈಪಿಂಗ್

ತಾಂತ್ರಿಕ ಪದಕೋಶ ತಾಂತ್ರಿಕ ಹಾಗು ಪಾರಿಭಾಷಿಕ ಕನ್ನಡ ಪದಗಳು

- Pedagogy/Course delivery tools: Ch Chalk and Talk, power point presentation

ಪಠ್ಯ ಪುಸ್ತಕ (text book):

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ'

ಸಂಪಾದಕರು : ಡಾ.ಹಿ,ಚಿ, ಬೋರಲಿಂಗಯ್ಯ –ವಿಶ್ರಾಂತ ಕುಲಪತಿಗಳು, ಕನ್ನಡ ವಿಶ್ವವಿದ್ಯಾಲಯ ,ಹಂಪಿ,ಪ್ರಸಾರಂಗ ವಿಶ್ವೇಶ್ವರಯ್ಯತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ,ಬೆಳಗಾವಿ,ಪ್ರಥಮ ಮುದ್ರಣ-2020

ಪೂರಕ ಪಠ್ಯ (reference book)

ಕನ್ನಡ ಮನಸು, ಪ್ರಸಾರಂಗ – ಕನ್ನಡ ವಿಶ್ವವಿದ್ಯಾಲಯ–ಹಂಪಿ,ಆರನೇಮುದ್ರಣ 2016

ಕನ್ನಡ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು:

- ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡದ ಜೊತೆಗೆ ಕ್ರಿಯಾತ್ಮಕ, ಸಾಹಿತ್ಯ ಮತ್ತು ಸಂಸ್ಕೃತಿ ಮತ್ತು ನಾಡು–ನುಡಿಯ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು (PO-6)
- ಕನ್ನಡ ಭಾಷೆಯ ವ್ಯಾಕರಣ, ಭಾಷಾರಚನೆ ಯ ನಿಯಮಗಳನ್ನು ಪರಿಚಯಿಸುವುದು(PO-10)
- ಕನ್ನಡ ಭಾಷಾಬರಹದಲ್ಲಿ ಕಂಡು ಬರುವ ದೋಷಗಳು ಮತ್ತು ಅವುಗಳ ನಿವಾರಣೆ(PO10)
- ಸಾಮಾನ್ಯ ಅರ್ಜಿಗಳು, ಸರ್ಕಾರಿ ಹಾಗು ಸರ್ಕಾರಿ ಪತ್ರವ್ಯವಹಾರದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು(PO-12)
- ಭಾಷಾಂತರ ಮತ್ತು ಪ್ರಬಂಧ ರಚನೆ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ,ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗು ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯ ಮಾಡಿಕೂಡುವುದು. (PO-12)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 marks		
Assessment tool	**Marks**	**Course outcome attained**
Internal test-1	30	CO1, CO2, CO3
Internal test-1I	30	CO4, CO5
Avarege of the Two Internal Test Two will be Taken for 30 Marks		
Other components		
Assignment	10	CO1, CO2
quiz	10	CO3, CO4, CO5
Semester end examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

ABILITY ENHANCEMENT COURSE - III	
Course Code: AEC310	**Credits:** 1:0:0
Pre – requisites: Nil	**Contact Hours:** 14L
Course Coordinator: Dr. Rama Shivakiran Reddy	

Ability Enhancement Courses (AEC) are the generic skill courses which are basic and needed by all to pursue any career. These courses are designed to help students enhance their skills in communication, language, and personality development. They also promote a deeper understanding of subjects like social sciences and ethics, culture and human behaviour, human rights and the law.

Every student shall register for AEC course under the supervision of his/her proctor. For III, IV & V semester, the student shall select the Ability Enhancement Course online such that the selected course does not overlap with any professional core/ elective course offered by the parent department of the student. After selection, the registration of the course has to be done by the student at his/her parent department.

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

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, Paschimotasana, Purvothanasana, Bharadwajasana, Amruthasana, Parivruttha Trikonasana, Parsvakonasana, Ustrasana, Padmasana, Jaaanushirshasana, Navasana, Ardhachakrasana, Ardhakatichakrasana, 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=HUzBCts7BTo

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 (CO's):

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
Pre – requisites: 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 $\int Sin^n x\ dx$, $\int Cos^n x\ dx$ and $\int Sin^n x\ Cos^m x\ dx$. Evaluation of double and triple integrals.

- 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 avector 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

NUMERICAL TECHNIQUES AND PROBABILITY MODELS	
Course Code: AI41	**Credits:** 2:1:0
Pre – requisites: Calculus and Basic Probability	**Contact Hours:** 28L+14T
Course Coordinator: Dr. Govindaraju M V and Dr. R Suresh Babu	

Unit I

Finite Differences and Interpolation: Forward and backward differences, Interpolation, Newton-Gregory forward and backward interpolation formulae, Lagrange's interpolation formula and Newton's divided difference interpolation formula (no proof).

Numerical Differentiation and Numerical Integration: Derivatives using Newton-Gregory forward and backward interpolation formulae, Newton-Cotes quadrature formula, Trapezoidal rule, Simpson's $1/3^{rd}$ rule and Simpson's $3/8^{th}$ rule.

- 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/111/106/111106101/
- Impartus recording: https://a.impartus.com/ilc/#/course/96127/452
  https://a.impartus.com/ilc/#/course/132243/636
  https://a.impartus.com/ilc/#/course/119635/593

Unit II

Statistics: Curve fitting by the method of least squares, fitting linear, quadratic and geometric curves, Correlation, Regression and Multiple Regression.

Probability Distributions: Random Variables, Binomial distribution, Poisson distribution

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://nptel.ac.in/courses/111/105/111105035/
- Impartus recording: https://a.impartus.com/ilc/#/course/96127/452
  https://a.impartus.com/ilc/#/course/132243/636
  https://a.impartus.com/ilc/#/course/119635/593

Unit III

Probability Distributions: Uniform distribution, Exponential distribution, Gamma distribution and Normal distribution.

Joint probability distribution: Joint probability distribution (both discrete and continuous), Conditional probability, Conditional expectation.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation, Videos
- Links: https://nptel.ac.in/courses/111/105/111105035/
  https://nptel.ac.in/courses/111/107/111107119/
- Impartus recording: https://a.impartus.com/ilc/#/course/96127/452
  https://a.impartus.com/ilc/#/course/119635/593

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 and Poisson processes.

Queuing theory: Introduction, Symbolic representation of a queuing model, Single server Poisson queuing model with infinite capacity (M/M/1 : ∞ /FIFO), when $\lambda_n = \lambda$ and $\mu_n = \mu$ $(\lambda < \mu)$, Performance measures of the model, Single server Poisson queuing model with finite capacity (M/M/S : N/FIFO), Performance measures of the model, Multiple server Poisson queuing model with infinite capacity (M/M/S : ∞ /FIFO), when $\lambda_n = \lambda$ for all n, $(\lambda < S\mu)$, 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://nptel.ac.in/courses/111103022
- Impartus recording: https://a.impartus.com/ilc/#/course/96127/452
  https://a.impartus.com/ilc/#/course/119635/593

Unit V

Sampling and Statistical Inference: Sampling distributions, Concepts of standard error and confidence interval, Central Limit Theorem, Type I and Type II errors, Level of significance, One tailed and two tailed tests, Z-test: for single mean, for single proportion, for difference between means, Student's t –test: for single mean, for difference between two means, F – test: for equality of two variances, Chi-square test: for goodness of fit, for independence of attributes.

- 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/111/107/111107119/

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. B.S.Grewal - Higher Engineering Mathematics - Khanna Publishers – 44th edition-2017.
3. T. Veerarajan- Probability, Statistics and Random processes – Tata McGraw-Hill Education – 3rd edition -2017.

Reference Books:

1. Erwin Kreyszig - Advanced Engineering Mathematics-Wiley-India publishers-10th edition-2015.
2. Sheldon M. Ross – Probability models for Computer Science – Academic Press, Elsevier– 2009.
3. Murray R Spiegel, John Schiller & R. Alu Srinivasan – Probability and Statistics – Schaum's outlines -4th edition-2012.
4. Kishore S. Trivedi – Probability & Statistics with Reliability, Queuing and Computer Science Applications – John Wiley & Sons – 2nd edition – 2008.
5. Johnson/Miller: Miller & Freund's Probability and Statistics for Engineers, Eighth Edition, Pearson Education India -2015

Course Outcomes (COs):

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

1. Find functional values, derivatives, areas and volumes numerically from a given data. (PO-1, 2 & PSO-2, 3)
2. Fit a least squares curve to the given data and analyze the given random data and its probability distributions. (PO-1, 2 & PSO-2, 3)
3. Find parameters of Continuous Probability distributions and calculate the marginal and conditional distributions of bivariate random variables. (PO-1, 2 & PSO-2, 3)
4. Predict future events using Markov chain and in queuing models. (PO-1, 2 & PSO-2, 3)
5. Choose an appropriate test of significance and make inference about the population from a sample. (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		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

DATA COMMUNICATION AND NETWORKING	
Course Code: AI42	**Credits:** 2:0:1
Pre – requisites: Basic Concepts of Electrical and Electronics	**Contact Hours:** 28L+14P
Course Coordinator: Dr. Meeradevi A K	

Unit I

Data Communications, Networks, Network Types, Network Models – Protocol layering, TCP/IP Protocol Suite, The OSI Model, Physical layer: Date Rate Limits, Performance Digital to Digital Conversion- Line coding: polar, unipolar, Block coding: 4B/5B, Analog to Digital Conversion -Pulse Code Modulation, Digital to Analog conversion- ASK, FSK, PSK, Analog to Analog conversion – AM, FM, PM. Multiplexing – FDM, TDM, Spread spectrum- FHSS, DHSS Switching – Circuit switching, packet switching

- Pedagogy/Course delivery tools : Chalk and talk, Power Point Presentation, Videos
- Links: https://nptel.ac.in/courses/106108098
  https://nptel.ac.in/courses/106105082
- Impartus Recording: https://a.impartus.com/ilc/#/course/96149/452

Unit II

Error Detection and Correction- Block Coding, Cyclic Codes – CRC, Polynomials, Cyclic code encoder using Polynomials. Checksum, Forward Error Correction: chunk interleaving. Data Link Layer: Data Link Control –DLC services: framing, Data link layer protocols – stop and wait protocol, Go-Back-N protocol, Selective Repeat Protocol. HDLC, Point to Point Protocol. Media Access Control – Random Access-CSMA/CD, CSMA/CA, Controlled access, Channelization

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://nptel.ac.in/courses/106108098
  https://nptel.ac.in/courses/106105082
- Impartus Recording: https://a.impartus.com/ilc/#/course/96149/452

Unit III

Wired LAN - Standard Ethernet, Wireless LANs- IEEE 802.11- Architecture, MAC sublayer, Addressing mechanism, Connecting Devices, Network Layer: IPV4 Addresses: Address space, Classful Addressing, Classless Addressing, Dynamic Host Configuration Protocol (DHCP), Network Address Translation (NAT). Routing

Algorithms: Link-State (LS) Routing Algorithm, The Distance-Vector (DV) Routing Algorithm

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://nptel.ac.in/courses/106108098
  https://nptel.ac.in/courses/106105082
- Impartus Recording: https://a.impartus.com/ilc/#/course/96149/452

Unit IV

Routing in the Internet: Intra-AS Routing in the Internet: RIP, Intra-AS Routing in the Internet: OSPF, Inter-AS Routing in the Internet: BGP. Transport layer: Multiplexing and Demultiplexing, Connectionless Transport- UDP: UDP Segment Structure, UDP Checksum, Connection-Oriented Transport-TCP: The TCP Connection, TCP Segment Structure, Round-Trip Time Estimation and Timeout, Reliable Data Transfer, Flow Control, TCP Connection Management, TCP congestion control.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://nptel.ac.in/courses/106108098
  https://nptel.ac.in/courses/106105082
- Impartus Recording: https://a.impartus.com/ilc/#/course/96149/452

Unit V

Application Layer: The Web and HTTP: Overview of HTTP, Non-Persistent and Persistent Connections, HTTP Message Format, User-Server Interaction- Cookies, Web Caching, The Conditional GET. File Transfer- FTP: FTP Commands and Replies, Electronic Mail in the Internet: SMTP, Comparison with HTTP, Mail Access Protocols. DNS—The Internet's Directory Service: Services Provided by DNS, Overview of How DNS Works, DNS Records and Messages, Peer-to Peer Applications: P2P File Distribution

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://nptel.ac.in/courses/106108098
  https://nptel.ac.in/courses/106105082
- Impartus Recording: https://a.impartus.com/ilc/#/course/96149/452

Suggested Learning Resources

Text Books:

1. Data Communication and Networking, Behrouz A.Forouzan, McGraw Hill, 5th Edition, 2008.
2. James F. Kurose and Keith W. Ross: Computer Networking: A Top- Down Approach, 6th edition, Addison-Wesley, 2013.

3. Forouzan: Data Communications and Networking, 5th edition, McGraw Hill Education 2013.

Reference Books:

1. Data and Computer Communication, William Stallings, 8th Edition, Pearson Education, 2007.
2. Introduction to Data Communications and Networking – Wayne Tomasi, Pearson Education, 2005.
3. Larry L. Peterson and Bruce S Davie: Computer Networks: A Systems Approach, Fifth Edition, Elsevier, 2011.
4. Tanenbaum: Computer Networks, 4th Ed, Pearson Education/PHI, 2003.
5. William Stallings: Data and Computer Communications, 8th Edition, Pearson Education, 2012.

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 (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
Lab Record	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 Lab Record		
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
Pre – requisites: Basic Programming	**Contact Hours:** 42L
Course Coordinator: Dr. Sowmya B J	

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(nk) 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.

- 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

Suggested Learning Resources

Textbook:

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 (COs) 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

THEORY OF COMPUTATION	
Course Code: AI44	**Credits:** 2:1:0
Pre – requisites: Basic Mathematics	**Contact Hours:** 28L+ 14T
Course Coordinator: Vinay T R	

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, equivalence of PDAs and CFGs.

- 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, closure properties of CFLs.

- 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, programming techniques for Turing Machines, extensions to the basic Turing machine, restricted Turing machines, Turing machine and computers, Undecidability:

A language that is not recursively enumerable, 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 (COs) 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

INTRODUCTION TO MACHINE LEARNING	
Course Code: AI45	**Credits:** 3:0:0
Pre – requisites: Linear Algebra	**Contact Hours:** 42L
Course Coordinator: Dr. Meeradevi A K	

Unit I

Introduction: Machine learning Landscape: what is ML?, Why, Types of ML, main challenges of ML Concept learning and Learning Problems – Designing Learning systems, Perspectives and Issues – Concept Learning – Find S-Version Spaces and Candidate Elimination Algorithm –Remarks on VS- Inductive bias.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://nptel.ac.in/courses/106106139
  https://nptel.ac.in/courses/106106202

Unit II

End to end Machine learning Project: Working with real data, Look at the big picture, Get the data, Discover and visualize the data, Prepare the data, select and train the model, Fine tune your model. Classification: MNIST, training a Binary classifier, performance measure, multiclass classification, error analysis, multi label classification, multi output classification

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://nptel.ac.in/courses/106106139
  https://nptel.ac.in/courses/106106202

Unit III

Training Models: Linear regression, gradient descent, polynomial regression, learning curves, regularized linear models, logistic regression Support Vector Machine: linear, Nonlinear, SVM regression and under the hood

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://nptel.ac.in/courses/106106139
- https://nptel.ac.in/courses/106106202

Unit IV

Decision Trees Training and Visualizing DT, making prediction, estimating class, the CART training, computational complexity, GINI impurity, Entropy, regularization

Hyper parameters, Regression, instability Ensemble learning and Random Forest: Voting classifiers, Bagging and pasting, Random patches, Random forests, Boosting, stacking

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://nptel.ac.in/courses/106106139
  https://nptel.ac.in/courses/106106202

Unit V

Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier– example-Bayesian Belief Network – EM Algorithm

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://nptel.ac.in/courses/106106139
  https://nptel.ac.in/courses/106106202

Suggested Learning Resources

Text Books:

1. Tom M. Mitchell, Machine Learning, McGraw-Hill Education, 2013
2. Aurelien Geron, Hands-on Machine Learning with Scikit-Learn &TensorFlow, O'Reilly, Shroff Publishers and Distributors Pvt. Ltd 2019

Reference Books:

1. Ethem Alpaydin, Introduction to Machine Learning, PHI Learning Pvt. Ltd, 2nd Ed., 2013
2. T. Hastie, R. Tibshirani, J. H. Friedman, The Elements of Statistical Learning, Springer, 1st edition, 2001
3. Machine Learning using Python, Manaranjan Pradhan, U Dinesh Kumar, Wiley, 2019
4. Machine Learning, Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, Pearson,2020

Course Outcomes (COs):

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

1. Understand the concept of Machine Learning and Concept Learning.
2. Apply the concept of ML and various classification methods in a project.

3. Analyse various training models in ML and the SVM algorithm to be implemented.
4. Apply the ML concept in a decision tree structure and implementation of Ensemble learning and Random Forest.
5. Apply Bayes techniques and explore more about the classification in ML.

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	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

ALGORITHMS LABORATORY	
Course Code: AIL46	**Credits:** 0:0:1
Pre – requisites: Basic C Programming	**Contact Hours:** 14P
Course Coordinator: Dr. Sowmya B J	

Course Contents

There shall be a minimum of two exercises conducted on each of the following topics:

1. Asymptotic bounds and functions.
2. Sorting techniques.
3. Stable matching.
4. Brute Force techniques.
5. Graph traversal techniques.
6. Divide and Conquer Techniques.
7. Greedy Algorithms.
8. Dynamic Programming.
9. Branch and Bound Techniques.

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 (COs) addressed**
Lab Test-I	10	CO1, CO2
Lab Test-II	10	CO3
Weekly Evaluation-Lab Record	30	-
The Final CIE out of 50 Marks = Marks of Lab Record + Marks scored in Lab Test-I + Marks scored in Lab Test-II		
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

MACHINE LEARNING LABORATORY	
Course Code: AIL47	**Credits:** 0:0:1
Pre – requisites: Basic Programming	**Contact Hours:** 14P
Course Coordinator: Dr. Meeradevi A K	

Course Contents

- For a given set of training data examples stored in a .CSV file, implement and demonstrate the Find-S algorithm to output a description of the set of all hypotheses consistent with the training examples.
- For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
- Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
- Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
- Write a program to implement the naive Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
- Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Python ML library classes/API.
- Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Python ML library classes/API in the program.
- Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
- Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs
- Implement and demonstrate the working of SVM algorithm for classification.

Suggested Learning Resources

Text Books:

1. Tom M Mitchell, "Machine Lerning",1st Edition, McGraw Hill Education, 2017.
2. Nello Cristianini, John Shawe-Taylor, An Introduction to Support Vector Machines and Other Kernel-based Learning Methods, Cambridge University Press, 2013.
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):

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

1. Understand the Importance of different classification and clustering algorithms.
2. Demonstrate the working of various algorithms with respect to training and test data sets.
3. Illustrate and analyze the principles of Instance based and Reinforcement learning techniques, Elicit the importance and Applications of Supervised and unsupervised machine learning, and Compare and contrast the Bayes theorem principles and Q learning approaches.

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Lab Test-I	10	CO1, CO2
Lab Test-II	10	CO3
Weekly Evaluation-Lab Record	30	-
The Final CIE out of 50 Marks = Marks of Lab Record + Marks scored in Lab Test-I + Marks scored in Lab Test-II		
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

PYTHON PROGRAMMING LABORATORY	
Course Code: AIL48	**Credits:** 0:0:1
Pre – requisites: Basic Programming	**Contact Hours:** 14P
Course Coordinator: Dr. Sowmya B J	

Course Contents

- Introduce the Python fundamentals, data types, operators, flow control and exception handling in Python
- Demonstrating creation of functions, passing parameters and return values
- Demonstration of manipulation of strings using string methods
- Discuss different collections like list, tuple and dictionary
- Demonstration of pattern recognition with and without using regular expressions
- Demonstration of reading, writing and organizing files.
- Demonstration of the concepts of classes, methods, objects and inheritance
- Demonstration of classes and methods with polymorphism and overriding
- Demonstration of working with excel spreadsheets and web scraping
- Demonstration of working with PDF, word and JSON files

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 (COs) addressed**
Lab Test-I	10	CO1, CO2
Lab Test-II	10	CO3
Weekly Evaluation-Lab Record	30	-
The Final CIE out of 50 Marks = Marks of Lab Record + Marks scored in Lab Test-I + Marks scored in Lab Test-II		
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

CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS	
Course Code: HS492	**Credits:** 1:0:0
Pre – requisites: Nil	**Contact Hours:** 14L
Course Coordinator: Mrs. Kanya Kumari S	

Course Content

Unit I

Introduction to the Constitution of India

Meaning and Significances of the Constitution, making of the Indian Constitution and its salient features, Preamble of the Constitution, Fundamental Rights and relevant cases.

- Pedagogy/Course delivery tools: Chalk and Talk, power point presentation

Unit II

Relevance of Directive Principles of State Policy -part-IV

Fundamental Duties & their significance. Special constitutional provisions for the betterment of Women, children and backward classes in India.

- Pedagogy/Course delivery tools: Chalk and Talk, power point presentation

Unit III

Union executive and State executive

President of India, Vice President, Prime Minister & Council of Ministers. The Union Legislature, Compositions & the functions of Parliament and the Supreme court of India -composition & Jurisdictions

State executive-Governor, Chief Minister& council of Ministers, State legislature-composition & functions of legislative assembly& legislative council and State Judiciary.

- Pedagogy/Course delivery tools: Chalk and Talk, power point presentation

Unit IV

Local self-Governments, Emergency provisions, Electoral process & Major Constitutional Amendments

Local Self Governments- Panchayath Raj system, Emergency provisions, election commission of India & Electoral process, Amendment procedure and Major Constitutional amendments.

- Pedagogy/Course delivery tools: Chalk and Talk, power point presentation

Unit V

Human Rights and Professional Ethics

Human Rights - meaning and significances of Human Rights. Universal Declaration of Human Rights (UDHR) protection of Human Rights in Indian Context. Scope and Aim of Ethics. Responsibility of Engineers, impediment to Responsibility.

- Pedagogy/Course delivery tools: Chalk and Talk, power point presentation

Text Books:

1. A Primer on Constitution of India & Professional ethics, VTU Publication-2007.

Reference Books:

1. Durga Das Basu,- ' Introduction to Constitution of India' - 19th /20th edition 2001
2. M.V.Pylee.- ' An Introduction to Constitution of India, 4th edition, 2008
3. Dr. K. R. Phaneesh,- 'Constitution of India & Professional ethics' –Sudha publication, Tenth revised edition 2018.

Course outcomes (COs):

At the end of the course students will be able to

1. Identify the fundamental principles of Indian constitution. (PO-12)
2. Examine various provisions of the Directive principles of state policies and fundamental duties. (PO-6, PO-12)
3. Understand the powers & functions of executive, Legislature and judicial system at the center and state level. (PO-6, PO-12)
4. Identify the role of government. (PO-12)
5. Understand about basic Human rights in India (PO-6, PO-8, PO-12)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 marks		
Assessment tool	**Marks**	**Course outcome attained**
Internal test-1	30	CO1, CO2, CO3
Internal test-1I	30	CO4, CO5
Average of the two internal tests will be taken for 30 marks.		
Other components		
Assignment	10	CO1, CO2
quiz	10	CO3, CO4, CO5
Semester end examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

ABILITY ENHANCEMENT COURSE - IV	
Course Code: AEC410	**Credits:** 1:0:0
Pre – requisites: Nil	**Contact Hours:** 14L
Course Coordinator: Dr. Rama Shivakiran Reddy	

Ability Enhancement Courses (AEC) are the generic skill courses which are basic and needed by all to pursue any career. These courses are designed to help students enhance their skills in communication, language, and personality development. They also promote a deeper understanding of subjects like social sciences and ethics, culture and human behaviour, human rights and the law.

Every student shall register for AEC course under the supervision of his/her proctor. For III, IV & V semester, the student shall select the Ability Enhancement Course online such that the selected course does not overlap with any professional core/ elective course offered by the parent department of the student. After selection, the registration of the course has to be done by the student at his/her parent department.

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

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
- Online tools: Use of open source software's to demonstrate methods and solve problems on interpolation
- 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
- Online tools: Use of open source software's to demonstrate methods and solve problems on numerical differentiation and integration.
- 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. **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. 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.