RAMAIAH
Institute of Technology

CURRICULUM

Academic Year 2026 – 2027

III & IV Semester
B. E. DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
BATCH 2025

RAMAIAH INSTITUTE OF TECHNOLOGY

(Autonomous Institute, Affiliated to VTU)

(Approved by AICTE, New Delhi & Govt. of Karnataka)

Accredited by NBA & NAAC with A^+ Grade

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 18 UG programs and 13 PG programs. All these programs are approved by AICTE. All eligible UG and PG programs are accredited by National Board of Accreditation (NBA). The institute is accredited with **'A^+' grade by NAAC in March 2021** for 5 years. University Grants Commission (UGC) & Visvesvaraya Technological University (VTU) have conferred Autonomous Status to MSRIT for both UG and PG Programs since 2007. The institute has also been conferred autonomous status for Ph.D. program since 2021. The institute is a participant to the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. The institute has 380 competent faculty out of which 70% are doctorates. Some of the distinguished features of MSRIT are: State of the art laboratories, individual computing facility for all faculty members, all research departments active with sponsored funded projects and more than 300 scholars pursuing Ph.D. To promote research culture, the institute has established Centre of Excellence for Imaging Technologies, Centre for Advanced Materials Technology, Centre for Antennas and Radio Frequency Systems (CARFS), Center for Cyber Physical Systems, Schneider Centre of Excellence & Centre for Bio and Energy Materials Innovation. **Ramaiah Institute of Technology has obtained All India Rank 182 in "Scimago Institutions Rankings" for the year 2024.**

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

As per the National Institutional Ranking Framework (NIRF), MoE, Government of India, Ramaiah Institute of Technology has achieved 75th rank among 1584 top Engineering Institutions & 31st Rank for School of Architecture in India among 131 Architecture Institutions, for the year 2025.

About the Department

Year of Establishment	1984
Names of the Programmes offered	UG: B.E. in Computer Science and Engineering PG: M.Tech. in Computer Science and Engineering PG: M.Tech. in Computer Networks and Engineering Ph.D M.Sc.(Engg.) by Research

The Department of Computer Science and Engineering (CSE) has eminent emeritus professors, 15 faculties with the doctorate degree and 15 pursuing the doctoral studies. The faculty has been publishing research papers in refereed journals and in conference proceedings. The department also conducts vocational courses and proficiency courses on fundamental and new programming languages and computer science concepts. These courses are conducted beyond college hours'/summer semester by the faculty of the department. Some of the faculty are involved in institutional level activities and actively involved in interdisciplinary research activities. The department has state of the art laboratories like SAP, IBM Centre of Excellence. Technical seminars, workshops and hackathons are conducted regularly for UG & PG students. The department encourages the students to conduct and participate in extra- curricular/sports activities. The alumni network is very active and regular meeting are conducted by the department. The department is accredited by Nation Board of Accreditation (NBA). The department has MoUs with leading IT Industries like SAP, IBM and HP. The department conducts subjects with more of hands- on sessions and encourages students to take up MOOC based online courses in NPTEL, IIT Bombay, Coursera, Udacity and edX.

VISION OF THE INSTITUTE

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

MISSION OF THE INSTITUTE

MSRIT shall meet the global socio-economic needs through

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

QUALITY POLICY

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

VISION OF THE DEPARTMENT

To build a strong learning and research environment in the field of Computer Science and Engineering that promotes innovation towards betterment of the society

MISSION OF THE DEPARTMENT

1. To produce Computer Science graduates who, trained in design and implementation of computational systems through competitive curriculum and research in collaboration with industry and research organizations.
2. To educate students in technology competencies by providing professionally committed faculty and staff.
3. To inculcate strong ethical values, leadership abilities and research capabilities in the minds of students so as to work towards the progress of the society.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

A B.E (Computer Science & Engineering) graduate of Ramaiah Institute of Technology should, within three to five years of graduation

PEO1 Pursue a successful career in the field of Computer Science & Engineering or a related field utilizing his/her education and contribute to the profession as an excellent employee, or as an entrepreneur.

PEO2 Be aware of the developments in the field of Computer Science & Engineering, continuously enhance their knowledge informally or by pursuing graduate studies.

PEO3 Be able to work effectively in multidisciplinary environments and be responsible members / leaders of their communities.

Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, reuse of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes

PROGRAM OUTCOMES (POs):

The Outcomes of the Bachelor of Engineering in Computer Science & Engineering Programme are as follows:

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 the world: 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: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO8: Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO9: 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.

PO10: 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.

PO11: 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.

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PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1: Understand the principles, architecture and organization of computers, embedded systems, and computer networks.

PSO2: Apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems that include both hardware and software.

PSO3: Apply software design and development practices to develop software applications in emerging areas such as IoT, Data Analytics, Social Networks, Cloud and High-Performance Computing.

Semester wise Credit Breakdown for B.E Degree Curriculum Batch 2025-29

Semester / Course Category	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Total Credits
Applied Sciences (ASC)	08	08	03	03	--	--	--	--	22
Engineering Sciences (ESC)	08	09	--	--	--	--	--	--	17
Humanities, Social Sciences and Management (HSMC)	02	02	--	--	03	03	--	--	10
Ability Enhancement Course (AEC)	02	01	01	01	01	01	02	--	09
Universal Human Values (UHV)	--	--	02	--	--	--	--	--	02
Professional Core Courses (PCC)	--	--	11	12	12	06	04	--	45
Professional Core Course (Integrated Course- IC)	--	--	04	04	03		04	--	15
Professional Elective Courses (PEC)	--	--	--	--	03	06	03	--	12
Open Elective Courses (OEC)	--	--	--	--	--	03	03	--	06
Internship (INT)	--	--	--	✔	--	--	--	05	05
Mini Project / Project Work (PW)	--	--	--	--	--	04	--	13	17
Non-Credit Mandatory Courses (NCMC)	--	--	--	--	✔	--	--	✔	--
Shill Lab	--	--	01	01	01	01	01		05
Total Credits	20	20	21	20	22	23	16	18	165

B E in COMPUTER SCIENCE AND ENGINEERING
SCHEME OF TEACHING
Batch 2025

III SEMESTER												
Sl. No.	**Course Code**	**Course**	**Teaching Department**	**Category**	**Credits**				**Total contact hours /week**			
					L	**T**	**P**	**Total**	**L**	**T**	**P**	**S**
1	**CS31**	Transform Techniques and Linear Algebra	Mathematics	BSC	2	1	0	3	2	2	0	2
2	**CS32**	Digital Design and Computer Organization	CSE	PCC(IC)	3	0	1	4	3	0	2	3
3	**CS33**	Data Structures	CSE	PCC	3	0	0	3	3	0	0	3
4	**CS34**	Object Oriented Programming	CSE	PCC	3	0	0	3	3	0	0	3
5	**CS35**	Discrete Mathematical Structures	CSE	PCC	2	1	0	3	2	2	0	2
6	**CSL36**	Data Structures Laboratory	CSE	PCC	0	0	1	1	0	0	2	0
7	**CSL37**	Object Oriented Programming Laboratory	CSE	PCC	0	0	1	1	0	0	2	0
8	**UHV38**	Universal Human Values	CSE	UHV	2	0	0	2	2	0	0	2
9	**CSAEC39**	Ability Enhancement Course- III	CSE	AEC	1	0	0	1	1	0	0	0
10	**CSESL1**	Skill Lab-1	Industry Expert	PCC	0	1	0	1	0	2	0	0
Total					**16**	**3**	**3**	**22**	**16**	**6**	**6**	**15**
11	**PE69**	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 VI semesters. Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree.							
	YO69	Yoga										
	NS69	NSS										

12	**AM31**	Additional Mathematics - I *****	Maths	NCMC	0	0	0	0	-

Nomenclature: ASC: Applied Science Course, **IC:** Integrated Course (Practical Integrated with Theory Course), **PCC:** Professional Core Course, UHV**:** Universal Human Value Course, AEC**:** Ability Enhancement Course, **NCMC:** Non-credit Mandatory Course

Credit Definition:

- **1 credit = 1 hour/week of lecture (L)**
- **1 credit = 2 hours/week of tutorial (T)**
- **1 credit = 2 hours/week of practical(P)**
- **1 credit = 1 hour/week of Self Learning Hours (S)**

The Program Core Course (IC) is an integrated course, combining theory with practical components.

- Theory sessions shall be conducted for 3 hours per week, while the practical sessions shall be conducted for 2 hours per week.
- Theory components shall be evaluated through both Continuous Internal Evaluation (CIE) and Semester End Examination (SEE).
- The practical component shall be assessed only through CIE (No SEE).
- However, questions from the practical component of the Integrated course (IC) can be included in the SEE question paper.

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

1. Student shall select any one of the NCMC's namely, Physical Education (Sport and Athletics)/Yoga/ NSS prescribed for four semesters and shall attend the course from the III semester to VI semester to complete all the formalities of the course and earn requisite CIE score. The Pass/Fail shall be reflected in the VI 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. CIE marks will be allotted by the concerned course teacher based on attendance and performance in the practice sessions/field every semester (III to VI) for 100 marks and marks scored by the student are scaled down to 100 in the VI semester.
4. 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.

Lateral Entry Students:

The Non-Credit Mandatory Course, Inter/Intra Institutional Internship: All the students admitted under lateral entry category shall have to undergo a mandatory Internship of 02 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 based on which a student will be declared pass or fail. The internship shall be considered as a head of passing for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete internship requirements during subsequent semesters.

Lateral Entry Students:

AICTE Activity Points Requirement for BE Programs: As per AICTE guidelines (refer Chapter 6 – *AICTE Activity Point Program, Model Internship Guidelines*), in addition to academic requirements, students must earn a specified number of **Activity Points** to be eligible for the award of the degree. The points to be earned is:

1. **Regular students** admitted to a 4-year degree program must earn **100 Activity Points**.

2. **Lateral entry students** (joining from the second year) must earn **75 Activity Points**.
3. **Students transferred** from other universities directly into the V semester must earn **50 Activity Points** from the date of entry into VTU.

These Activity Points are non-credit and will not be considered for the SGPA/CGPA or be used for vertical progression. However, earning Activity Points is mandatory for the award of the degree, and the points earned will be reflected on the eighth semester Grade Card. If a student completes all the semesters (eight or six) at the end of the program but fails to earn the required Activity Points, the VIII semester Grade Card will be withheld until the requirement is fulfilled. Also, the degree will be awarded only after the Grade Card has been released. The hours spent earning the activity points will not be counted for regular attendance requirements. Students can accumulate these points at any time during their program period, including weekends, holidays, and vacations, starting from the year of admission, provided they meet the minimum hours of engagement prescribed for each activity by AICTE.

B E in COMPUTER SCIENCE AND ENGINEERING
SCHEME OF TEACHING
Batch 2025

IV SEMESTER												
Sl. No.	**Course Code**	**Course**	**Teaching Department**	**Category**	**Credits**				**Total contact hours /week**			
					L	**T**	**P**	**Total**	**L**	**T**	**P**	**S**
1	**CS41**	Probability, Statistical Inference and Optimization	Mathematics	BSC	2	1	0	3	2	2	0	2
2	**CS42**	Microcontrollers and IoT	CSE	PCC(IC)	3	0	1	4	3	0	2	3
3	**CS43**	Design and Analysis of Algorithms	CSE	PCC	3	0	0	3	3	0	0	3
4	**CS44**	Operating Systems	CSE	PCC	3	0	0	3	3	0	0	3
5	**CS45**	Database Systems	CSE	PCC	2	1	0	3	2	2	0	3
6	**CSL46**	Design and Analysis of Algorithms Laboratory	CSE	PCC	0	0	1	1	0	0	2	0
7	**CSL47**	Database Modelling Laboratory	CSE	PCC	0	0	1	1	0	0	2	0
8	**CSL48**	Systems programming lab	CSE	PCC	0	0	1	1	0	0	2	0
9	**CSAEC49/410**	Ability Enhancement Course - IV	CSE	AEC	1	0	0	1	1	0	0	0
10	**INT410**	Inter/ Intra Institutional Internship		NCMC	0	0	0	0				
11	**CSESL2**	Skill Lab-2	Industry Expert	PCC	0	1	0	1	0	2	0	0
	Total				**14**	**3**	**4**	**21**	**14**	**4**	**8**	**14**

12	**AM41**	Additional Mathematics II *	Maths	NCMC	0	0	0	0	-

Nomenclature: ASC: Applied Science Course, **IC:** Integrated Course (Practical Integrated with Theory Course), **PCC:** Professional Core Course, AEC**:** Ability Enhancement Course, **NCMC:** Non-credit Mandatory Course

Credit Definition:

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- **1 credit = 1 hour/week of Self Learning Hours (S)**

The Program Core Course (IC) is an integrated course, combining theory with practical components.

- Theory sessions shall be conducted for 3 hours per week, while the practical sessions shall be conducted for 2 hours per week.
- Theory components shall be evaluated through both Continuous Internal Evaluation (CIE) and Semester End Examination (SEE).
- The practical component shall be assessed only through CIE (No SEE).
- However, questions from the practical component of the Integrated course (IC) can be included in the SEE question paper.

*** Lateral Entry Students:**

The Non-Credit Mandatory Course, Additional Mathematics II: is prescribed for IV Semester Lateral Entry Diploma students admitted to III Semester of BE Program. The student shall register for this course along with other IV semester courses. The students shall attend classes for the course during the semester and complete all formalities of attendance and CIE. In case, any student fails to secure the minimum 40% of the prescribed CIE marks, he/she shall be deemed to have secured 'F' grade. In such a case, the student has to fulfill the requirements during subsequent semester/s to appear for CIE. Incase

student fails to register for the said course/ falls short of attendance, he/she will repeat the course whenever it is offered next. Additional Mathematics II shall have CIE component only and no SEE component. This Course shall not be considered for vertical progression, but completion of the course shall be mandatory for the award of the degree.

Lateral Entry Students:

The Non-Credit Mandatory Course, Inter/Intra Institutional Internship: All the students admitted under lateral entry category shall have to undergo a mandatory Internship of 02 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 based on which a student will be declared pass or fail. The internship shall be considered as a head of passing for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete internship requirements during subsequent semesters.

Lateral Entry Students:

AICTE Activity Points Requirement for BE Programs: As per AICTE guidelines (refer Chapter 6 – *AICTE Activity Point Program, Model Internship Guidelines*), in addition to academic requirements, students must earn a specified number of **Activity Points** to be eligible for the award of the degree. The points to be earned is:

1. **Regular students** admitted to a 4-year degree program must earn **100 Activity Points**.
2. **Lateral entry students** (joining from the second year) must earn **75 Activity Points**.
3. **Students transferred** from other universities directly into the V semester must earn **50 Activity Points** from the date of entry into VTU.

These Activity Points are non-credit and will not be considered for the SGPA/CGPA or be used for vertical progression. However, earning Activity Points is mandatory for the award of the degree, and the points earned will be reflected on the eighth semester Grade Card. If a student completes all the semesters (eight or six) at the end of the program but fails to earn the required Activity Points, the VIII semester Grade Card will be withheld until the requirement is fulfilled. Also, the degree will be awarded only after the Grade Card has been released. The hours spent earning the activity points will not be counted for regular attendance requirements. Students can accumulate these points at any time during their program period, including weekends, holidays, and vacations, starting from the year of admission, provided they meet the minimum hours of engagement prescribed for each activity by AICTE.

III SEMESTER

Transform Techniques and Linear Algebra	
Course Code: CS31	**Credits:** 2:1:0
Pre-requisites: Calculus and Basics of Linear Algebra	Contact Hours: 30L+T+30S
Course Coordinators: Dr. Govindaraju M V	

Course Content

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.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://nptel.ac.in/courses/111/105/111105134/
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Unit II

Application of Laplace Transforms: Laplace transform of periodic function. Unit–step function, unit–impulse function. inverse transforms, convolution theorem. **S**olution of linear differential equations and simultaneous linear differential equations using Laplace transforms.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://nptel.ac.in/courses/111/105/111105134/

Unit III

Z transforms: Z-transform of Standard functions, Properties of Z-transforms, Convergence of Z-transforms, Inverse Z-transform, Application of Z-transforms to solve difference equations, linear recurrence relations.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://nptel.ac.in/courses/111106111
  https://a.impartus.com/ilc/#/course/2975585/1331

Unit IV

Orthogonal Projections: Review of vector space, complement subspaces, orthogonality of four fundamental subspaces and its dimensions, QR-factorization, the complete solution to Ax = b, least-squares approximations, constraint optimization. Quadratic forms, positive definite matrices.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://nptel.ac.in/courses/106108482
  https://web.mit.edu/18.06/www

Unit V

Applications of Eigenvalue Decomposition: Introduction to eigenvalues and eigenvectors, similarity and diagonalization. symmetric matrices, complex matrices, Hermitian and unitary matrices, positive definite

matrices, the singular value decomposition (SVD), principal component analysis (PCA), applications to linear recurrence relations, quadratic forms and conic sections.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation, Videos
- Links: https://nptel.ac.in/courses/106108482
  https://web.mit.edu/18.06/www

Text Books:

1. Kreyszig, E. (2025). Advanced Engineering Mathematics (11th ed.). Wiley-India Publishers.
2. Lay, D. C., Lay, S. R., & McDonald, J. J. (2021). Linear Algebra and its Applications (6th ed.). Pearson.
3. Strang, G. (2016). Linear Algebra and its Applications (5th ed.).

Reference Books:

1. O'Neil, P. V. (2023). Advanced Engineering Mathematics (8th ed.). Cengage Learning.
2. Williams, G. (2019). Linear Algebra with Applications (9th ed.). Jones and Bartlett Press.
3. Grewal, B. S. (2024). Higher Engineering Mathematics (45th ed.). Khanna Publishers.

Course Outcomes (COs):

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

1. Apply the properties of Laplace transforms to evaluate integrals and transform elementary functions. (PO-1, 2 & PSO-2, 3)
2. Solve linear and simultaneous differential equations by employing inverse Laplace transforms, convolution. (PO-1, 2 & PSO-2, 3)
3. Utilize Z-transforms and their properties to analyze convergence and solve linear recurrence relations and difference equations. (PO-1, 2 & PSO-2, 3)
4. Analyze vector spaces through orthogonal projections, QR-factorization, least-squares approximations, and the optimization of quadratic forms. (PO-1, 2 & PSO-2, 3)
5. Construct solutions for real-world systems using eigenvalue decomposition, Singular Value Decomposition (SVD), and Principal Component Analysis (PCA). (PO-1, 2 & PSO-2, 3)

Course Assessment and Evaluation:

Continuous Internal Evaluation: 50		
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	**Marks**	**Course outcomes addressed**
Quiz	10	CO1,CO2,CO3
Assignment	10	CO3,CO4,CO5
Semester End Examination (SEE)		
Course end examination(Answer any one question from each unit – Internal choice)	100	CO1,CO2,CO3,CO4,CO5

DIGITAL DESIGN AND COMPUTER ORGANIZATION	
Course Code: CS32	**Credits: 3:0:1**
Pre – requisites: Nil	**Contact Hours: 45L+15P+45S**
Course Coordinator: Dr. Chandrika Prasad	

Course Content

Unit I

Optimized implementation of logic function and combinational circuits:

Synthesis of logic circuits with SOP and POS, K-map, Strategy for minimization, Minimization of SOP and POS forms, incompletely specified functions. Tabular method for minimization of Boolean functions, Combinational circuits: Half adder, full adder (realization using NAND gates), multiplexers, decoders, encoders and code converters.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Links: https://nptel.ac.in/courses/117105078
- Lab Component / Practical Topics: Implement Half and Full Adder in VHDL
  Implement 8:1 MUX in VHDL

Unit II

Flip-flops, registers and counters:

Basic latch, gated SR latch, gated D latch, T FF, JK FF, truth table, characteristics equation and excitation tables of all the four types of FFs. Registers: Shift registers, parallel access registers. Study of asynchronous counters: Up, down counters. Study of synchronous sequential circuits: Design of a counter using sequential circuits approach using different FFs for different modulo values and design of random counters

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Links: https://nptel.ac.in/courses/117105078
- Lab Component / Practical Topics: Design a JK flip-flop (with preset and clear) in VHDL Design and develop the VHDL code for mod 8 up counter

Unit III

Introduction to functional units and addressing modes:

Functional units, bus structures, performance, **Overflow in integer arithmetic**: Numbers, Arithmetic operations and characters, Memory locations and addresses, Memory operations, instructions and instruction sequencing, Addressing modes, Encoding of machine instructions.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Links: https://nptel.ac.in/courses/117105078
- Lab Component / Practical Topics: Instruction execution using Marie simulator

  Execution of Assembly language programs using ARMSim simulator

Unit IV

Processor:

Arithmetic unit: Multiplication of two numbers, A signed operand multiplication, Booth algorithm, Bit pair recoding and CSA, IEEE standard for floating point numbers. **The Processor:** Fundamental concepts, Execution of complete instruction, Multiple bus organization, **Pipelining**: Basic concepts, Data hazards,

Instruction hazards.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Links: https://nptel.ac.in/courses/117105078
- Lab Component / Practical Topics: ALU design using Logisim and Pipelining demonstration using CPU-OS Simulator

Unit V

Memory and I/O Units:

Memory unit: Basic concepts, Cache mapping techniques, **Input Output Unit:** Accessing I/O devices, **Interrupts**: Interrupt hardware, Enabling and disabling of interrupts, handling multiple devices, Controlling device requests.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Links: https://nptel.ac.in/courses/117105078
- Lab Component / Practical Topics: Memory operation using Logisim simulator

Suggested Learning Resources

Text Books:

1. Stephen Brown, Zvonko Vranesic: Fundamentals of Digital Logic Design with VHDL, Tata McGraw Hill, 3rd Edition, 2012.
2. C Hamacher, Z Vranesic, S Zaky: Computer Organization, Tata McGraw Hill, 5th Edition, 2018.

Reference Book:

1. David A. Patterson, John L. Hennessy: Computer Organization and Design, M.K Publishers, 4th edition, 2010

Course Outcomes (COs):

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

1. Interpret the working of various digital combinational circuits and apply various techniques to minimize Boolean functions. (PO-1,2, PSO-2)
2. Examine the characteristics of flip flop sand design asynchronous and synchronous sequential circuits. (PO-1,2, 5, PSO-2)
3. Demonstrate basic functional units, instruction sequencing and various addressing modes. (PO-1,2,5, PSO-2)
4. Appraise different techniques used to perform multiplication and describe the organization of processing unit & pipelining. (PO-1,2, 3,5, PSO-2)
5. Illustrate cache memory mapping techniques, data transfer between the devices using interrupts and direct memory access mechanism (PO-1,2,3,5, PSO-2)

Course Assessment and Evaluation:

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

DATA STRUCTURES	
Course Code: CS33	**Credits: 3:0:0**
Pre – requisites: C Programming Course	**Contact Hours: 45L+45S**
Course Coordinator: Dr. Sushma B	

Course Content

Unit I

Basic Concepts: Pointers and Dynamic Memory allocation, Data Abstraction, Introduction to Structures: Structures, Internal Representation of Structures, Self-referential Structures, Polynomials, Sparse Matrix: The Abstract Data Type, Sparse matrix Representation, Transposing a Matrix .**Stacks:** Stacks, Stacks using Dynamic Arrays**,** Evaluation of expression

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Lab Component / Practical Topics: Implementing Polynomials, Sparse Matrices, Stacks Operations and its Applications.
- Links: https://www.youtube.com/watch?v=rS-ZKTqwi90

Unit II

Queues: Queues, Circular queue using Dynamic arrays.**Linked Lists:** Singly Linked lists and chains, Representing Chains in C, Linked Stacks and Queues, Additional List operations, Sparse Matrices: Sparse Matrix Representation, Doubly Linked Lists.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Lab Component / Practical Topics: Circular Queues, Variations of Linked Lists Operations.
- Links: https://www.youtube.com/watch?v=R9PTBwOzceo

Unit III

Trees: Introduction, Binary Trees, Binary Tree Traversals, Threaded Binary Trees, Heaps, Binary Search Trees, Selection Trees, Forests, Counting Binary Trees.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Lab Component / Practical Topics: Different types of Binary Trees.
- Links: https://www.youtube.com/watch?v=oSWTXtMglKE

Unit IV

Priority Queues: Single- and Double-Ended Priority Queue, Leftist Trees. Efficient Binary Search Trees: AVL Trees.

Graphs: The Graph Abstract Data Type, Elementary Graph Operations.: Depth First Search and Breadth First Search.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Lab Component / Practical Topics: Applications of Priority Queues and Graphs Traversals
- Links: https://www.youtube.com/watch?v=gXgEDyodOJU

Unit V

Sorting: Quick sort, Marge Sort – Merging, Recursive Merge Sort, Heap Sort.**Hashing:** Introduction, Static Hashing: Hash tables, Hashing Function, Overflow handling, Dynamic Hashing: Dynamic Hashing Using Directories

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Lab Component / Practical Topics: Sorting Techniques and Different types of Hashing.

- Links:https://www.youtube.com/watch?v=wWgIAphfn2U&list=PLqM7alHXFySGwXaessYMemAnITqlZdZVE

Suggested Learning Resources

Text Book:

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

Reference Books:

1. Narasimha Karumanchi: Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles, Career monk Publications, 5th Edition, 2016
2. Yedidyah, Augenstein, Tannenbaum: Data Structures Using C and C++, 2nd Edition, Pearson Education, 2003.
3. Data Structures, Seynour Lipschutz and GAV Pai, Schaum's Outlines, McGraw Hill, 2008.
4. 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. Implement abstract data types using pointers, structures, and dynamic memory allocation for polynomial representation, sparse matrices, and stack-based expression evaluation. (PO-1,2,3, PSO-2)
2. Design linear data structures such as queues, circular queues, linked lists, sparse matrix representations, and doubly linked list operations using dynamic memory allocation and pointers. (PO-1,2,3, PSO-2)
3. Construct binary trees and implement tree traversal algorithms to solve hierarchical and recursive problems using appropriate tree representations. (PO-1,2,3, PSO-2)
4. Develop efficient searching and graph traversal solutions using advanced data structures such as AVL trees, priority queues, and graph representations. (PO-1,2,3,5, PSO-2)
5. Analyze sorting algorithms and hashing techniques for efficient data organization, retrieval, and collision resolution in real-world applications. (PO-1,2,3,5, PSO-2)

Course Assessment and Evaluation:

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

OBJECT ORIENTED PROGRAMMING	
Course Code: CS34	**Credits: 3:0:0**
Pre – requisites: C Programming Course	**Contact Hours: 45L+45S**
Course Coordinator: Pradeep Kumar D	

Course Content

Unit I

Introduction to Java Programming: Introduction to OOPs**,** Java's Magic: The Byte code; Java Buzzwords, Overview of Java Data types, Variables, arrays, Control statements.

Java Programming Fundamentals: Object-Oriented Programming, The Three OOP Principles, Class Fundamentals, Declaring Objects, Assigning Object Reference Variables, Introducing Methods, Constructors, the This Keyword, Garbage Collection.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Links: https://nptel.ac.in/courses/106105191
- Lab Component / Practical Topics: Java Programs on data types, operators, static methods and arrays

Unit II

Java Methods, Classes and Inheritance

A Closer Look at Methods and Classes: Overloading Methods, Using Objects as Parameters, A Closer Look at Argument Passing, Returning Objects, Introducing Access Control, understanding static, introducing final, Introducing Nested and Inner Classes.

Inheritance: Inheritance Basics, using super, creating a Multilevel Hierarchy, When Constructors Are Called, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Links: https://nptel.ac.in/courses/106105191
- Lab Component / Practical Topics: Java Programs on classes, constructors, method overloading, method overriding and nested classes and Inheritance

Unit III

Packages, Interfaces and Exception Handling

Packages & Interfaces: Packages, Access Protection, Importing Packages, Interfaces.

Exception Handling: Exception-Handling Fundamentals, Exception Classes, Exception Types, Uncaught Exceptions, using try and catch, Multiple catch clauses, Nested try Statements, throw, throws, finally..

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Links: https://nptel.ac.in/courses/106105191
- Lab Component / Practical Topics: Java Programs on abstract classes, packages, interfaces and Exception handling.

Unit IV

String Handling and Multithreaded Programming

String Handling: The string Constructors, String Length, Special String Operations, Character Extraction, String Comparison, Searching String, Modifying a String, Data Conversion Using valueOf( ), Changing the Case of Characters Within a String, and String Buffer.

Multithreaded Programming: Java Thread Classes, The Java Thread Model, The Main Thread, creating a Thread, Creating Multiple Threads, Using is Alive() and join(), Thread Priorities, Synchronization, Suspending, Resuming and Stopping Threads.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Links: https://nptel.ac.in/courses/106105191
- Lab Component / Practical Topics: Java Programs on String handling and Multithreaded programming

Unit V

Collections and Introducing Swings

The Collections Framework: The Collection Interfaces, The Collection Classes, Accessing a Collection via an Iterator. Working with Maps: Map Interfaces and Map Classes.

Introducing Swings: Two Key Swing features, MVC Connection, Components and Containers, Swing Packages, Event Handling, Exploring Swing: JLabel, JTextField, Buttons, TabbedPane, ScrollPane, JList. Swing Menus: JMenuBar, JMenu and JMenuItem. MainMenu..

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Links: https://nptel.ac.in/courses/106105191
- Lab Component / Practical Topics: Java Programs on Collections, Maps, and Swing Applications.

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 :97881317228793.
2. The Complete Reference-Java, Herbert Schildt, 12th Edition, 2021, TMH Publications, ISBN: 9781260463415.

Reference Book:

1. Head First Java, Kathy Sierra and Bert Bates, 2nd Edition, 2014, Oreilly Publication, ISBN :978817366602

Course Outcomes (COs):

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

1. Identify classes and objects for object oriented programming and explore on OOP Principles. (PO1, PO-3, PO-8, PO-9, PO-10, PO-11, PSO2, PSO3)
2. Construct the class and Methods along with developing Java Programs using Inheritance (PO1, PO-2, PO-3, PO-4, PO-5, PO-8, PO-9, PO-10, PO-11, PSO2, PSO-3).
3. Develop java programs using interfaces, packages and exception handling. (PO1, PO-2, PO-3, PO-4, PO-5, PO-8, PO-9, PO-10, PO-11, PSO2, PSO-3).
4. Develop programs on string handling and thread synchronization. (PO1, PO-2, PO-3, PO-4, PO-5, PO-8, PO-9, PO-10, PO-11, PSO2, PSO-3).
5. Design the Java application using Collections and Swings (PO1, PO-2, PO-3, PO-4, PO-5, PO-8, PO-9, PO-10, PO-11, PSO2, PSO-3).

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1, CO2, CO3
Internal Test-II CIE-II)	30	CO4, CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Quiz –I	10	CO1, CO2, CO3
Quiz –II	10	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 Quiz-II		
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: CS35	**Credits: 2:1:0**
Pre – requisites: Nil	**Contact Hours: 30L+15T+30S**
Course Coordinator: Dr. Seema S	

Course Content

Unit I

Logics and Proofs: The laws of Logic, Logical implication, Rules of inference, Quantifiers, Proofs of theorems.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Links: https://onlinecourses.nptel.ac.in/noc22_cs123
- Tutorial Component / Practical Topics: Problems on Logic

Unit II

Relations: Relations, Properties of relations, Computer Recognition- Zero-one Matrices and directed Graphs, Equivalence Relations and partitions. POSETS, Hasse Diagrams, Lattices.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Links: https://onlinecourses.nptel.ac.in/noc22_cs123
- Tutorial Component / Practical Topics: Problems on POSET

Unit III

Combinatorics: Fundamentals of counting, permutation, combination, Combination with repetition, Binomial Coefficient, Pigeon hole principle. The Principle of Inclusion and Exclusion: The Principle of Inclusion and Exclusion, Generalizations of the Principle, Derangements – Nothing is in its Right Place, Rook Polynomials.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Links: https://onlinecourses.nptel.ac.in/noc22_cs123
- Tutorial Component / Practical Topics: Problems on permutation, combination

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://onlinecourses.nptel.ac.in/noc22_cs123
- Tutorial Component / Practical Topics: Problems on Graph Theory and Applications

Unit V

Applications of Graphs and Trees: Network flow problems, flows and source/sink cuts, Ford Fulkerson algorithm, Trees: Definitions, Properties, and Examples, Rooted Trees, Weighted Trees and Prefix Codes. Optimising Timetable Scheduling via Graph Coloring Techniques, Social Network analysis: Degree centrality, Cliques, Bridge edges, Betweenness centrality, Assignment Problem and Optimization.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Links: https://onlinecourses.nptel.ac.in/noc22_cs123,

https://w ww.youtube.com/watch?v=Tzp2SzUighk,

https://www.youtube.com/watch?v=kvbCDu4giAY
https://www.youtube.com/watch?v=BRznQMCdVKs,
https://www.youtube.com/watch?v=q_TpEw1oxnA

- Tutorial Component / Practical Topics:Problems and Trees

Suggested Learning Resources

Text Books:

1. Ralph P. Grimaldi: Discrete and Combinatorial mathematics, 5th Edition, PHI/ Pearson Education, 2015.
2. Kenneth H. Rosen: Discrete Mathematics and its Applications, 7th Edition, McGraw Hill publications.
3. Douglas B. West, Introduction to Graph Theory, Second Edition, Prentice-Hall.

Reference Book:

1. Thomas Koshy: Discrete Mathematics with Applications, Elsevier, 1st Edition, 2011.

Course Outcomes (COs):

At the end of the course, the students will be able to:
1 .Apply the notion of mathematical logic & proofs in problem solving. (PO-1,2,3,4,9,11. PSO- 2,3)
2. Solve problems which involve discrete data structures such as relations (PO-1,2,3,4,9,11. PSO-2)
3. Apply basic counting techniques and combinatorics in the context of discrete probability. (PO-1,2,3,4,9,11. PSO-2)
4. Demonstrate knowledge of fundamental concepts in graphs (PO-1,2,3,4,9,11. PSO-2)
5. Demonstrate knowledge of trees and its properties using various modelling techniques. (PO- 1,2,3,4,9,11. PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1, CO2, CO3
Internal Test-II CIE-II)	30	CO4, CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Tutorial Session	10	CO1, CO2, CO3, CO4, CO5
Project on applications of DMS concepts	10	CO1, CO2, CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Tutorial session +Marks Scored in Project Evaluation		
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: CSL36	**Credits: 0:0:1**
Pre – requisites: C Programming Course	**Contact Hours: 15P**
Course Coordinator: Dr. Sangeetha J	

Course Content

Design, develop and implement the specified programs for the following problems using C Programming Language in LINUX environment.

1. Managing Structures in applications
    - Addition of Polynomials
    - Sparse Matrix
2. Organizing Stacks in programs
    - Infix expression to Postfix expression
    - Evaluation of Postfix expression
3. Constructing Queues for applications
    - Circular queue
4. Constructing Linked Lists for applications
    - stack operations using linked lists
    - queue operations using linked lists
    - Usage of doubly linked list
5. Binary Tree
    - Binary Search Tree Traversal
    - Threaded Binary Tree and Traversal using inorder threading
6. Priority queues
    - Max heap
7. Developing applications to solve Graph based problems
    - Depth First Search
    - Breadth First Search
8. Sorting Techniques
    - Merge sort
9. Hashing
    - Using open addressing with linear probing

Quiz:

To reinforce the understanding of core Data Structures such as Arrays, Linked Lists, Stacks, Queues, Trees, and Graphs, a set of weekly quizzes will be assigned to students. These quizzes will include objective and conceptual questions designed to test their theoretical knowledge and practical application skills. The structured assessments aim to strengthen foundational concepts, improve analytical thinking, and prepare students for technical interviews and competitive exams**.**

Suggested Learning Resources

Reference Books/ Web Links:

5. Narasimha Karumanchi: Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles, Career monk Publications, 5th Edition, 2016
6. Yedidyah, Augenstein, Tannenbaum: Data Structures Using C and C++, 2nd Edition, Pearson Education, 2003.
7. Data Structures, Seynour Lipschutz and GAV Pai, Schaum's Outlines, McGraw Hill, 2008.
8. 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, the students will be able to:

1. Implement polynomial operations, sparse matrix multiplication, infix-to-postfix conversion, postfix expression evaluation, and pointer-based dynamic memory allocation programs. (PO-1, PO-2, PO-3, PSO-2)
2. Implement linear data structures such as queues, circular queues, and linked lists using dynamic memory allocation and pointers for efficient data storage and access. (PO-1, PO-2, PO-3, PSO-2)
3. Develop applications using hierarchical and non-linear data structures such as binary search trees, threaded binary trees, heaps, graphs, sorting algorithms, and hashing techniques through a mini-project for efficient data organization and retrieval. (PO-1, PO-2, PO-3, PO-11, PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Lab Test	20	CO1, CO2, CO3
Weekly Evaluation-Lab Record	20	CO1, CO2, CO3
Quiz	10	CO1, CO2, CO3
The Final CIE out of 50 Marks = Marks of Lab Record + Marks scored in Lab Test-I + Marks scored in Quiz		
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: CSL37	**Credits: 0:0:1**
Pre – requisites: C Programming Course	**Contact Hours: 30P**
Course Coordinator: Pradeep Kumar D	

Course Contents

Sl. No.	Topics Covered
1.	Primitive Data type and Operators
2.	Control Statements and Arrays
3.	Classes, objects, static variables
4.	Method overloading, method overriding
5.	Dynamic method dispatch, abstract classes
6.	Inheritance
7.	Interfaces & Packages
8.	String handling
9.	Exception Handling
10.	Multi-threading
11.	Synchronizing the threads
12.	Event Handling
13.	Programs on Swings
14.	Lambda Expressions

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

Suggested Learning Resources

Reference Books/ Web Links:

1. The Complete Reference - Java, Herbert Schildt, 12th Edition, 2021, TMH Publications, ISBN: 9781260463415.
2. Head First Java, Kathy Sierra and Bert Bates, 3rd Edition, 2022, O'Reilly Publication, ISBN:9781491910771

Course Outcomes (COs):

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

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

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Lab Test-I	10	CO1, CO2
Lab Test-II	10	CO3
Weekly Evaluation-Lab Record	30	CO1, CO2, CO3
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: -	**Contact Hours: 30L+30S**
Course Coordinator: Veena G S	

Course Content

Unit I

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

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

Unit II

Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
2. Understanding the needs of Self ('I') and 'Body' - *Sukh* and *Suvidha*
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
4. Understanding the characteristics and activities of 'I' and harmony in 'I'
5. Understanding the harmony of I with the Body: *Sanyam* and *Swasthya*; correct appraisal of Physical needs, meaning of Prosperity in detail
6. Programs to ensure *Sanyam* and *Swasthya*
7. 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
     Harmony in Human Being- Self https://youtu.be/83oGJ4oDeIg
     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
  Harmony in family- Respecthttps://youtu.be/iLqNRPuv0_8
  Harmony in family- Other Feeling Justice https://youtu.be/TcYJB7reKnM
  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
   - 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
     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:

1. At the level of individual: as socially and ecologically responsible engineers, technologists and managers
2. At the level of society: as mutually enriching institutions and organizations

Suggested Learning Resources:

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

Text Book:

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

Reference Books:

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

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw
2. https://www.youtube.com/watch?v=P4vjfE-YnVk&list=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, 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

MASTERING OFFICE	
Course Code: CSAEC310	**Credits: 1:0:0**
Pre – requisites: Nil	**Contact Hours: 15L+15S**
Course Coordinator: - Brunda G	

Course Content

Unit I

MS-Word -Working with Files, Text – Formatting, Moving, copying and pasting text, Styles – Lists – Bulleted and numbered lists, Nested lists, Formatting lists. Table Manipulations. Graphics – Adding clip Art, add an image from a file, editing graphics, Page formatting - Header and footers, page numbers, Protect the Document, Mail Merge, Macros – Creating & Saving web pages, Hyperlinks.

- Pedagogy /Course delivery tools: Chalk and board, Active Learning, practical based learning

Unit II

MS-Excel- Modifying a Worksheet – Moving through cells, adding worksheets, rows and columns, Resizing rows and columns, selecting cells, Moving and copying cells, freezing panes - Macros – recording and running. Linking worksheets - Sorting and Filling, Alternating text and numbers with Auto fill, Auto filling functions. Graphics – Adding clip art, add an image from a file, Charts – Using chart Wizard, Copy a chart to Microsoft Word.

- Pedagogy / Course delivery tools: Active Learning, Demonstration, presentation

Unit III

MS-Power Point -Create a Presentation from a template- Working with Slides – Insert a new slide, applying a design template, changing slide layouts – Resizing a text box, Text box properties, delete a text box - Video and Audio effects, Color Schemes & Backgrounds Adding clip art, adding an image from a file, Save as a web page.

- Pedagogy / Course delivery tools: Demonstration, presentation preparation for case studies

Unit IV

MS-Access - Using Access database wizard, pages and projects. Creating Tables – Create a Table in design view. Datasheet Records – Adding, Editing, deleting records, Adding and deleting columns Resizing rows and columns, finding data in a table & replacing, Print a datasheet. Queries - MS-Access.

- Pedagogy / Course delivery tools: Chalk& board, Practical based learning.

Unit V

Microsoft Outlook- Introduction, Starting Microsoft Outlook, Outlook Today, Different Views In Outlook, Outlook Data Files.

- Pedagogy / Course delivery tools: Chalk& board, Practical based learning.

Course Outcomes :

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

1. Know the basics of computers and prepare documents, spreadsheets, make small presentations with audio, video and graphs and would be acquainted with internet.

Create, edit, save and print documents with list tables, header, footer, graphic, spellchecker, mail merge and grammar checker

Attain the knowledge about spreadsheet with formula, macros spell checker etc.

Demonstrate the ability to apply application software in an office environment.

Use Google Suite for office data management tasks

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1,CO2, & CO3
Internal Test-II CIE-II)	30	CO4, & CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Quiz –I	10	CO1,CO2, & CO3
Assignment –I	10	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 –I		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3 CO4 & CO5

UNIX SHELL PROGRAMMING	
Course Code: CSAEC39	**Credits: 1:0:0**
Pre – requisites: C Programming	**Contact Hours: 15L+15S**
Course Coordinator: Dr. Chandrika Prasad/ Mamatha A	

Course Content

Unit I

Introduction to UNIX - Architecture of UNIX, Features of UNIX, Introduction to UNIX file system, vi editor, file handling utilities, security by file permissions, Basic UNIX commands (PATH,man,echo, printf, script, passwd, uname, who, date, stty, pwd, cd, mkdir, rmdir, ls, cp, mv, rm, cat, more, wc, lp, od, tar, gzip.)

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Basic Linux commands execution on terminal
- Links: https://www.geeksforgeeks.org/linux-unix/introduction-to-unix-system/,https://www.geeksforgeeks.org/linux-unix/introduction-to-unix-system/

Unit II

Introduction to Shells- UNIX Session, UNIX utilities, process utilities, disk utilities, networking commands, Text processing utilities, backup utilities.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Linux command related to process/disk/text processing execution on terminal
- Links: https://www.tecmint.com/ps-command-examples-for-linux-process-monitoring/, https://ss64.com/

Unit III

Standard Streams- Redirection, Pipes, Tee Command, Command Execution, Quotes, Command Substitution, Aliases, Variables, Environment Variables.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Customization of Linux shell environment and redirection commands
- Links: https://computing.stat.berkeley.edu/tutorial-using-bash/using-commands.html

Unit IV

Filters- Filters and Pipes, Concatenating Files, Display Beginning and End of Files, Cut and Paste, Sorting. Translating Characters, Files with Duplicate Lines, Regular Expressions using grep.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Linux commands execution related to filters on terminal
- Links: https://www.geeksforgeeks.org/linux-unix/pipes-and-filters-in-linux-unix,https://www.digitalocean.com/community/tutorials/using-grep-regular-expressions-to search-for-text-patterns-in-linux

Unit V

Shell Scripts- read Making Scripts Interactive, Using Command Line Arguments, exit and Exit Status of Command Logical Operators (&&, ||), Conditional Execution, The if Conditional Using test and [] to Evaluate Expressions, The case Conditional expr: Computation and String Handling $0: Calling a Script by Different Names while: Looping, for: Looping with a List set and shift: Manipulating the Positional Parameters.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation Videos
- Lab Component / Practical Topics: Linux commands execution related to shell scripts
- Links: https://linuxcommand.org/lc3_wss0120.php,https://www.geeksforgeeks.org/linux-unix/conditional-statements-shell-script/

Text Books:

UNIX: Concepts and Applications, Sumitabha Das, Fourth edition, McGraw Hill Publishing Company Limited.

Course Outcomes (COs):

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

1. Describe UNIX architecture, features, file system, and basic commands for text editing in the vi editor. (PO-1,2,5,8,11, PSO-2)
2. Apply UNIX/Linux commands and utilities to manage processes, storage, networking, and backups through command line. (PO-1,2,3,5,8,11, PSO-2)
3. Apply standard streams, redirection, pipes, and command execution techniques to efficiently manage UNIX environments. (PO-1,2,3,5,8,11, PSO-2)
4. Apply filters, pipes, and regular expressions to manipulate, process, and analyze text data efficiently in UNIX. (PO-1,2,3,5,8,11, PSO-2)
5. Implement shell scripts using control structures, command-line arguments, logical operators, and loops to automate tasks in a UNIX environment. (PO-1, 2, 3, 5, 8,11, PSO-2)

Course Assessment and Evaluation:

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

PHYSICAL EDUCATION	
Course Code: PE63	**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):

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

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 8^{th} Semester.
6. The final marks shall be calculated after scaling down CIE to 50 marks & combining with 50 marks for SEE.

YOGA	
Course Code: YO63	**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 students will be able to:

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: NS63	**Credits: NCMC**
Pre – requisites: Nil	
Course Coordinator: Dr. Puttabore Gowda & Dr. Siddaraju C	

Course Learning Objectives:

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

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

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

Course Outcomes (COs):

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

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

Contact Sessions:

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

Course Assessment & Evaluation:

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

ADDITIONAL MATHEMATICS - I	
Course Code: AM31	**Credits: 0:0:0**
Pre – requisites: Nil	**Contact Hours: 45L**
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. **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

Probability, Statistical Inference and Optimization	
Course Code: CS41	**Credits: 2:1:0**
Pre – requisites: Basic Probability	**Contact Hours: 30L+15T+30S**
Course Coordinator: Dr. Govindaraju M V	

Course Content

Unit I

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/

Unit II

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/
  https://a.impartus.com/ilc/#/course/96151/1112

Unit III

Stochastic Processes: Introduction, Classification of stochastic processes, Discrete time processes, Stationary stochastic processes, Autocorrelation, Ergodicity.

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

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://nptel.ac.in/courses/111103022
  https://a.impartus.com/ilc/#/course/96127/452

Unit IV

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

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://nptel.ac.in/courses/111/105/111105035/
  https://nptel.ac.in/courses/111/107/111107119/

Unit V

Linear Programming: Introduction to linear programming problem (LPP), formulation of the problem, graphical method, general, canonical and standard forms of LPP, simplex method, big-M method, two-phase simplex method and duality in linear programming.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://nptel.ac.in/courses/111104027

Text Books:

1. Kreyszig, E. (2025). Advanced Engineering Mathematics (11th ed.). Wiley-India Publishers.
2. Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (2022). Probability and Statistics for Engineers and Scientists (9th ed.). Pearson Education, Delhi.
3. Veerarajan, T. (2017). Probability, Statistics and Random Processes (3rd ed.). Tata McGraw-Hill Education.
4. Swarup, K., Gupta, P. K., & Mohan, M. (2014). Operations Research. Sultan Chand & Sons Publishers.

Reference Books:

1. Grewal, B. S. (2024). Higher Engineering Mathematics (45th ed.). Khanna Publishers.
2. Ross, S. M. (2009). Probability models for Computer Science (13th ed.). Academic Press, Elsevier.
3. Spiegel, M. R., Schiller, J., & Srinivasan, R. A. (2013). Probability and Statistics (4th ed.). Schaum's Outlines. McGraw-Hill.
4. Trivedi, K. S. (2008). Probability & Statistics with Reliability, Queuing and Computer Science Applications (2nd ed.). John Wiley & Sons.
5. Johnson, R. A., & Miller, I. (2015). Miller & Freund's Probability and Statistics for Engineers (8th ed.). Pearson Education India.

Course Outcomes (COs):

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

1. Apply the method of least squares for single and multivariable curve fitting, analyze correlation/regression, and evaluate data using discrete probability distributions. (PO-1, 2 & PSO-2, 3)
2. Analyze continuous probability distributions and evaluate joint, conditional, and expected values for multi-variable random scenarios. (PO-1, 2 & PSO-2, 3)
3. Examine the properties of stochastic processes and determine steady-state behaviors using Markov chains and transition probability matrices. (PO-1, 2 & PSO-2, 3)
4. Choose and apply appropriate statistical significance tests (Z, t, F,and χ^2) to make valid inferences about a population from sample data. (PO-1, 2 & PSO-2, 3)
5. Formulate and solve Linear Programming Problems using graphical, simplex, dual, and artificial variable techniques for optimal resource allocation. (PO-1, 2 & PSO-2, 3)

Course Assessment and Evaluation:

Continuous Internal Evaluation: 50		
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	**Marks**	**Course outcomes addressed**
Quiz	10	CO1,CO2,CO3
Assignment	10	CO3,CO4,CO5
Semester End Examination (SEE)		
Course end examination(Answer any one question from each unit – Internal choice)	100	CO1,CO2,CO3,CO4,CO5

MICROCONTOLLERS & IoT	
Course Code: CS42	**Credits: 3:0:1**
Pre – requisites: Basic Electronics	**Contact Hours: 45L+15P+45S**
Course Coordinator: Veena G S	

Course Content

Unit I

Introduction to Microcontrollers and IoT

Introduction to Cortex M0: General discussion on Microcontrollers, Cortex-M0 Technical Overview, System Features, implementation Features, Debug Features, Programming model, Operation Modes and States, Architecture, Registers and Special Registers Behaviors of the Application Program Status Register (APSR), Memory System Overview. Introduction to Cortex-M0 Programming, Stack memory operation.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Links: https://onlinecourses.nptel.ac.in/noc22_cs53/
- Lab Component / Practical Topics: Introduction to keil software, Use of simulation

Unit II

Instruction Set: Cortex M0

Instruction Set: Instruction Set, Instruction Usage Examples, implementation of various structures like loop, switch, functions, and subroutines. Memory System, Exceptions and Interrupts.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Links: https://onlinecourses.nptel.ac.in/noc22_cs53/
- Lab Component / Practical Topics: Study use of interrupts and peripherals like Keyboard

Unit III

Smart Objects: The "Things" in IoT, Sensors, Actuators, and Smart Objects, Workflow of a Sensor in a typical system, Classification of Sensors, Sampling DAC and ADC conversion. Introduction to Actuators: Workflow of an Actuator in a typical system, Classification of Actuators. Types of Sensors.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation.
- Links: https://onlinecourses.nptel.ac.in/noc22_cs53/
- Lab Component / Practical Topics: Study of ADC programs and graphical LCD 128x64.

Unit IV

IoT Network and Transport layer handling IoT Access Technologies. IP as the IoT Network Layer, The Business Case for IP, The need for Optimization Low Bandwidth Wireless Networks: FSK, LoRa modulation basics, LoRaWAN basics. Optimizing IP for IoT: HTTP, AMQP, MQTT and STOMP.

- Pedagogy / Course delivery tools: Power point presentation, Demo of Sensor and actuator utility.
- Links: https://onlinecourses.nptel.ac.in/noc22_cs53/
- Lab Component / Practical Topics: Use of Node MCU and NodeRed

Unit V

Programming IoT Physical Devices and Endpoints Programming IoT Physical Devices and Endpoints – Raspberry Pi: Introduction to Raspberry Pi, About the Raspberry Pi Board: Hardware Layout, Operating Systems on Raspberry Pi, Configuring Raspberry Pi, Programming Raspberry Pi with Python, Connecting

Raspberry Pi via SSH, Smart and Connected Cities, An IoT Strategy for Smarter Cities, Smart City IoT Architecture, Smart City Security Architecture, Smart City Use-Case Examples.

- Pedagogy / Course delivery tools: Power point presentation, Demo using Raspberry pi board and sensors
- Links: https://onlinecourses.nptel.ac.in/noc22_cs53/
- Lab Component / Practical Topics: Usage of raspberry pi with MQTT, HTTP, Ethernet and Wi-Fi for IoT Projects

Suggested Learning Resources

Text Books:

1. Joseph Yiu, "The Definitive Guide to the ARMCortex-M0",1st edition, Newnes – an imprintt of Elsevier, 2011.
2. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014. (ISBN:978-8173719547)
3. Srinivasa K G, Siddesh G.M and Hanumantha Raju R ―Internet of Things, CENGAGE Leaning India, 2017. (ISBN:978-93-868-5895-5).

Reference Books:

1. Designing the Internet of Things by Adrian McEwen Smart Cities, Software above the level of a single device, Ebooks on IoT by O'Reilly
2. Sentilo middleware http://www.sentilo.io/xwiki/bin/view/Sentilo.About.Product/Whatis
3. Mosquitto broker https://mosquitto.org/
4. Getting started with raspberry pihttps://www.raspberrypi.org/resources/learn/
5. Wired peripheral protocolshttp://www.comm.pub.ro/dicm/C7_Serial_Bus.pdf
6. LoRa Modulationhttp://www.semtech.com/images/datasheet/an1200.22.pdf

Course Outcomes (COs):

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

1. Evaluate microcontroller architecture, (cortexM0 Overview), evaluate operation Modes and States using special purpose registers. (PO-1, 2, 3, 4, PSO-1)
2. Evaluate cortex M0 in assembly instructions and be able program in assembly level programs using CMSIS features. (PO-3,4,5,11, PSO-2)
3. Compare and contrast the deployment of smart objects and the technologies to connect them to network. (PO-3, 4, 5, 11, PSO-2)
4. Use of Various network and application protocols for IoT (PO-3, 4, 5, 11, PSO-2)
5. Developing a perspective for IoT Applications in various domains. (PO-3, 4, 5, 11, PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1, CO2, CO3
Internal Test-II CIE-II)	30	CO4, CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Laboratory Test and Laboratory datasheet evaluation	10	CO1, CO2, CO3
Quiz	10	CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Laboratory Test +Marks scored in Quiz		
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: CS43	**Credits: 3:0:0**
Pre–requisites: Data Structures & Programming Language	**Contact Hours: 45L+45S**
Course Coordinator: Pradeep Kumar	

Course Content

Unit I
Introduction and Basics of algorithm analysis

Introduction: Some Representative Problems. A First Problem: Stable Matching, Five Representative Problems. Basics of Algorithm Analysis: Computational Tractability, Asymptotic Order of Growth, A Survey of Common Running Times. Mathematical Analysis of Non-recursive and Recursive Algorithms**.**
Brute Force: Selection Sort and Bubble Sort.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Links: https://nptel.ac.in/courses/106106131
- Lab Component / Practical Topics: Asymptotic notation, computing running time of the algorithms

Unit II
Divide & Conquer and Decrease & conquer

Decrease-and-Conquer: Topological Sorting, Algorithms for Generating Combinatorial Objects: Generating Permutations, Decrease by-a-Constant- Factor Algorithms: Russian Peasant Multiplication, Variable Size-Decrease Algorithms: Computing Median and the Selection Problem.
Divide and Conquer: General method, Recurrence equation for divide and conquer, Merge sort, Quick sort, Strassen's matrix multiplication, Advantages and Disadvantages of divide and conquer.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Links: https://nptel.ac.in/courses/106106131
- Lab Component / Practical Topics: Programs on BFS, DFS, Merge sort, Counting inversion, Quicksort

Unit III
Greedy Algorithms

Space and Time Tradeoffs: Horspool's Algorithm, Boyer-Moore Algorithm.
Greedy Algorithms: Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Huffman Trees.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Links: https://nptel.ac.in/courses/106106131
- Lab Component / Practical Topics: Programs on Prims, Kruskal, Dijkstra's algorithms

Unit IV
Dynamic Programming

Dynamic Programming: Basic Examples: Coin-row Problem, Change Making Problem, Coin collecting problem, Knapsack problem and Memory Functions, Optimal Binary Search Trees, Warshall's and Floyd's Algorithms, Bellman-Ford Algorithm.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Links: https://nptel.ac.in/courses/106106131
- Lab Component / Practical Topics: Programs on Weighted interval scheduling, Knapsack, Subset sum and Belman ford algorithm

Unit V

NP, Branch-and-Bound and Backtracking

NP-Completeness: Polynomial time, Non-Deterministic Polynomial-time, NP-Complete Problems: The Clique problem, The Vertex Cover problem. **Backtracking:** n-Queens Problem, Subset-Sum Problem. **Branch-and-Bound**: Knapsack Problem, Traveling Salesman Problem.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Links: https://nptel.ac.in/courses/106106131
- Lab Component / Practical Topics: Programs on Traveling salesman problem and n-Queens problem

Text Books:

1. Jon Kleinberg and Eva Tardos: Algorithm Design, Pearson, 1st Edition (2013).
2. Introduction to the Design and Analysis of Algorithms, Anany Levitin,3rd, Pearson, 2014.

Reference Book:

1. Ellis Horowitz, Sartaj Sahni and S Rajasekaran: Fundamentals of Computer Algorithms, 2nd Edition, Universities Press, 2017. ISBN: 9788173716126

Video Lectures (e-Resources):

- https://a.impartus.com/ilc/#/course/270273/452

Course Outcomes (COs):

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

1. Define the fundamental concepts of algorithms and analyze their efficiency using asymptotic and mathematical tools. (PO-1, 2, 3, 4, 11, PSO-2)
2. Apply problem-solving strategies by breaking complex problems into simpler subproblems and combining partial solutions effectively (PO-1, 2, 3, 4, 11, PSO-2)
3. Design efficient solutions to optimization problems and assess their performance based on time and space complexity. (PO-1, 2, 3, 4, 11, PSO-2)
4. Solve computational problems involving overlapping subproblems and optimal substructure by applying suitable approaches. (PO-1, 2, 3, 4, 11, PSO-2)
5. Apply problem-solving strategies for complex and combinatorial problems, and analyze their computational feasibility in terms of tractability and complexity classes (PO-1, 2, 3, 4, 11, PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1, CO2, CO3
Internal Test-II CIE-II)	30	CO4, CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Quiz –I	10	CO1, CO2, CO3
Quiz –II	10	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 Quiz-II		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

OPERATING SYSTEM	
Course Code: CS44	**Credits: 3:0:0**
Pre – requisites: Computer Organization	**Contact Hours: 45L+45S**
Course Coordinator: Dr. Chandrika Prasad	

Course Content

Unit I

Introduction to Operating Systems- What operating systems do, Operating System operations, Process management, Memory management, Storage management, Protection and security**. System Structures-** Operating System Services, System calls, Operating System design and implementation, Operating System structure, Virtual machines**.**

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Links: https://archive.nptel.ac.in/courses/106/105/106105214/
- Lab Component / Practical Topics: Nil

Unit II

Process Management - Process concept, Process scheduling, Operations on processes, Inter-process communication. **Process Scheduling-** Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple-Processor scheduling. **Process Synchronization-** Background, The Critical section problem, Synchronization hardware, Semaphores, Classical problems of synchronization.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Links: https://archive.nptel.ac.in/courses/106/105/106105214/
- Lab Component / Practical Topics: Nil

Unit III

Deadlocks- System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance**. Memory Management Strategies-** Background, Swapping, Contiguous memory allocation, Paging, Structure of page table, Segmentation. **Virtual Memory Management-** Background, Demand paging, Page replacement.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Links: https://archive.nptel.ac.in/courses/106/105/106105214/
- Lab Component / Practical Topics: Nil

Unit IV

File System- File concept, Access methods, Directory structure, Protection. **Implementing File System-** File system structure, File system implementation, Directory implementation, Allocation methods, Free space management, Disk scheduling algorithms.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Links: https://archive.nptel.ac.in/courses/106/105/106105214/
- Lab Component / Practical Topics: Nil

Unit V

Dockers-Docker Basics and Architecture, what is containerization, how are containers different from physical machines and VMs, Docker evolution and architecture, Developments in Docker world, Docker tooling, Basic Docker commands. **Docker Networking-** Introduction, Types of Docker networks, Using Networks, Identifying container networks, **Docker Volumes-**Managing

data in Docker containers with volumes, Volume file systems and basic Docker image file systems, Creating and managing volumes.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Links: https://archive.nptel.ac.in/courses/106/105/106105214/
- Lab Component / Practical Topics: Nil

Text Books:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne: Operating System Principles, 9th edition, Wiley-India, 2012.

Reference Books:

1. William Stallings: Operating systems Internals and Design Principles | Ninth Edition, Pearson Education, 2018
2. Remzi H. Arpaci-Dusseau and Andrea C. Arpaci-Dusseau, Operating systems: Three easy pieces, URL : http://pages.cs.wisc.edu/~remzi/OSTEP/
3. James Turnbull: The Docker Book: Containerization is the new virtualization Kindle Edition, Kindle Edition, 2014

Link (e-Resources):

1. URL: https://docs.docker.com/
2. https://archive.nptel.ac.in/courses/106/105/106105214/

Course Outcomes (COs):

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

1. Describe operating system operations and operating system structures (PO-1, 2, PSO-2).
2. Implement various scheduling algorithms and concurrency control techniques to provide co-ordination among threads and processes (PO-1, 2, 3, 4, PSO-2).
3. Examine various methods for handling deadlocks and memory management techniques (PO-1, 2, 3, 4, PSO-2).
4. Demonstrate different directory structure, file allocation methods and disk scheduling algorithms used for managing the disk (PO-1,2,3, PSO-2)
5. Illustrate Dockers techniques for various networking and file system applications (PO1, 2, 3, 4,5,9,10,11, PSO-2).

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 & CO3
Internal Test-II CIE-II)	30	CO4 & CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Quiz	10	CO1, CO2, CO3 & CO4
Uploading Project on Cloud Using Dockers and Containers	10	CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Quiz + Project Implementation		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4 and CO5

DATABASE SYSTEMS	
Course Code: CS45	**Credits: 2:1:0**
Pre – requisites: Nil	**Contact Hours: 30L+15T+30S**
Course Coordinator: Dr. Ganeshayya Shidaganti	

Course Content

Unit I

Introduction: Characteristics of Database Approach, Actors on the Scene, Workers behind the Scene, Advantages of using DBMS approach, Data Models, Schemas and Instances, Three-Schema Architecture and Data Independence, Database Languages and Interfaces, The Database System Environment, Centralized and Client-Server Architectures for DBMS, Classification of Database Management Systems, **Entity-Relationship Model:** 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.ER Design for COMPANY Database,

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Links: https://nptel.ac.in/courses/106105175
- Lab Component / Practical Topics: Design an ER schema for a database application

Unit II

Relational Model and Constraints Relational Model Concepts, Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions and Dealing with Constraint violations. **Relational Algebra:** 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/106105175
- Lab Component / Practical Topics: Implement Unary and Binary Operations using Relational Algebra.

Unit III

Introduction to SQL: SQL Data Definition and Data Types, Specifying Constraints in SQL, Scheme Change Statements in SQL, Basic Queries in SQL, More Complex SQL Queries, INSERT, DELETE and UPDAT Statements in SQL, Specifying Constraints as Assertions and Triggers, Views(Virtual Tables) in SQL, Introduction **to SQL Programming Techniques:** Database programming Issues and Techniques, Embedded SQL. Database Programming with Function Calls: SQL and JDBC

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Links: https://nptel.ac.in/courses/106105175
- Lab Component / Practical Topics: Implementation of Database Applications using SQL and Programming Techniques.

Unit IV

Functional Dependencies and Normalization: Informal Design Guidelines for Relation Schemas, Functional Dependencies, Normal Forms based on Primary Keys, General Definitions of second Database Systems and third Normal Forms, Boyce Codd Normal Forms, **Relational Database Design:** Properties of Relational Decompositions**,** Algorithms for Relational Database Schema Design. Multivalued Dependencies and Fourth Normal Form. Join Dependencies and Fifth Normal Form.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos

- Links: https://nptel.ac.in/courses/106105175
- Lab Component / Practical Topics: Implement of Functional Dependencies and Normalization Techniques.

Unit V

Transaction Processing Concepts: Introduction to Transaction Processing, Transaction and System Concepts, Desirable Properties of Transactions, Characterizing Schedules based on Serializability. **Concurrency Control Techniques:** Two-Phase Locking Techniques for concurrency Control, Concurrency Control based on Timestamp Ordering, Multi-version Concurrency Control Techniques. Database Recovery Techniques and Algorithms.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos
- Links: https://nptel.ac.in/courses/106105175
- Lab Component / Practical Topics: Implement of Transaction Processing Algorithms and Techniques.

Text Books:

1. Elmasri and Navathe: Fundamentals of Database Systems, 7th Edition, Pearson, 2016.
2. Silberschatz, Korth and Sudharshan: Data base System Concepts, 6th Edition, Tata McGraw Hill, 2011.
3. C.J. Date, A. Kannan, S. Swamynatham: An Introduction to Database Systems, 8th Edition, Pearson education, 2009.

Reference Book:

1. "Database Management Systems" by Raghu Ramakrishnan, Johanners Gehrke, Second Edition. McGraw-Hill Education

Video Lectures (e-Resources):

- https://nptel.ac.in/courses/106105175

Course Outcomes (COs):

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

1. Design Entity–Relationship diagrams for simple database applications and explain the advantages of database systems. (PO-2, 3, 4, 5, PSO-2)
2. Construct relational algebra expressions for queries and map ER models to relational schemas. *(*PO-1, 2, 4, PSO-2)
3. Develop SQL solutions for queries, data definition, and update operations. (PO-2, 3, 4, 5, PSO-2)
4. Apply normalization techniques to enhance relational database design. (PO-1, 2, PSO-2)
5. Analyze transaction processing, concurrency control, and recovery techniques in database systems. (PO-3, 4, PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 & CO3
Internal Test-II CIE-II)	30	CO4 & CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Quiz –I/Online Certificate	10	CO1, CO2 & CO3
Quiz –II/Project Implementation	10	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 Quiz-II		
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 LAB	
Course Code: CSL46	**Credits: 0:0:1**
Pre–requisites: Data Structures & Java Programming	**Contact Hours: 15P**
Course Coordinator: Pradeep Kumar D/Mamatha A	

Course Contents

Design, develop and implement the specified algorithms for the following problems using JAVA programming Language in LINUX/Windows environment.

1. Apply divide and conquer strategy to solve sorting problems
    - Merge sort
    - Quicksort
2. Apply decrease and conquer strategy to solve graph problem
    - Topological sorting using depth first search
3. Apply greedy strategy to solve graph problems
    - Dijkstra's algorithm
    - Prim's algorithm
    - Kruskal's algorithm
4. Apply input enhancement strategy to solve string-matching problems
    - Horspool's algorithm
    - Boyer – Moore's algorithm
5. Apply dynamic programming strategy to solve optimization problems
    - Warshall – Floyd's Algorithms
    - Knapsack problem solution using memory function.
    - Bellman-Ford algorithm
6. Apply backtracking strategy to solve combinatorial problems
    - N- Queen's problem
    - Subset – sum problem
7. Apply branch and bound strategy to solve combinatorial problems
    - Travelling salesperson problem
    - Assignment problem

LeetCode Exercises:

To complement the lab programs focused on algorithmic strategies such as Divide and Conquer**,** Greedy Techniques**,** Dynamic Programming**,** Backtracking**,** and Branch and Bound, a curated list of LeetCode exercises will be selected and assigned to students on a weekly basis**.** These coding problems are intended to reinforce theoretical concepts through practical application in a real-world programming environment. This structured practice will not only deepen students understanding of core algorithms but also enhance their problem-solving abilities, preparing them effectively for technical interviews and competitive programming**.**

Suggested Learning Resources

Reference Books/ Web Links:

1. Algorithm Design - Jon Kleinberg and Eva Tardos, Pearson, 1st Edition (2013).
2. Anany Levitin: Introduction to the Design & Analysis of Algorithms, 3rd Edition, Pearson Education, 2012. ISBN:9780132316811

Course Outcomes (COs):

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

1. Apply algorithmic design strategies like divide and conquer, decrease and conquer, and greedy to solve problems related to sorting and graph theory. (PO-1, 2, 3, 5, 11, PSO-2)
2. Analyze string matching and optimization problems using techniques such as input enhancement, dynamic programming, and graph-based algorithms (PO-1, 2, 3, 4, 5, 11, PSO-2)
3. Apply backtracking and branch-and-bound strategies to solve combinatorial and decision-making problems. (PO-1, 2, 3, 5, 11, PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Lab Test-I	10	CO1, CO2
Lab Test-II	10	CO3
Weekly Evaluation-Lab Record	20	-
LeetCode Exercises	10	CO1, CO2, CO3
The Final CIE out of 50 Marks = Marks of Lab Record+ LeetCode Exercises + 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 Java and executed)	50	CO1, CO2, CO3

DATABASE LABORATORY	
Course Code: CSL47	**Credits: 0:0:1**
Pre – requisites: Nil	**Contact Hours: 15P**
Course Coordinator: Dr. Ganeshayya Shidaganti	

Course Contents

1. Introduction to Entity-Relationship (ER) Model
2. Design an Entity-Relationship (ER) Model and Mapping to Relational Model
3. Introduction SQL Databases: Oracle/ MySQL
4. Implement SQL Queries using DDL, DML and DCL Statements
5. Build an Applications in Oracle DB using simple and Complex Quires
6. Build an Application in Oracle DB using Triggers and Views
7. Introduction NoSQL Databases: Mongo DB
8. Implement NoSQL Queries using CRUD Operations.
9. Building Modern Applications in Mongo DB using NoSQL.
10. Building a Database application for a particular case study using Visual Basic/Java Script in visual studio/Eclipse Tool.

Text Books:

1. "Database Management Systems" by RaghRamakrishnan, JohannersGehrke, Second Edition. McGraw-HillEducation.
2. "Fundamentals of Database Systems" by RamezElmasri, Shamkant B. bNavathe, Fifth Edition, Pearson Publications.
3. "Database System Concepts" by Abraham Silberschatz, Henry F. Korth, sixth Edition, McGraw Hill Education.

Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/106105175
2. https://erdplus.com/

Course Outcomes (COs):

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

1. Demonstrate the Core MongoDB Operations (PO-2, PSO-1,2)
2. Design an Oracle DB Application Using SQL DDL statements, DML statements and Queries (PO-1,3, PSO-1,2)
3. Develop a Real Time Database Application Using IDE/Tools of student's choice (PO-1, 3, PSO-1,2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test (CIE)	20	CO1, CO2, CO3
Regularity/ Continuous assessment	20	CO1, CO2, CO3
Other Components		
Online Certificate/ Project Implementation	10	CO1, CO2, CO3
The Final CIE out of 50 Marks = Marks of Continuous Assessment &Project Implementation + Marks scored in Lab Test		
Semester End Examination (SEE)		
Course End Examination	50	CO1, CO2, CO3

SYSTEMS PROGRAMMING LABORATORY	
Course Code: CSL48	**Credits: 0:0:1**
Prerequisite: Computer Organization	**Contact Hours: 15P**
Course Coordinator: Dr. Chandrika Prasad	

Course Contents

1. Basic file I/O functions and properties of a file.
2. File Types, File access permission and File links.
3. Virtualizing process and memory
4. Process creation, execution and termination include fork, vfork, exec and wait system calls
5. Process Scheduling using FIFO, RR and priority algorithms
6. Process synchronization implementing locks and semaphore
7. Resource management by employing deadlock avoidance algorithms
8. Memory allocation strategies illustration with bestfit, worst fit and first fit algorithms
9. Page replacement algorithms using FIFO, Optimal and LRU techniques
10. Files and directory structures demonstration with several organization techniques like list, index and graph algorithms.

Text Books:

1. Stephen Rago, W. Stevens, Advanced Programming in the UNIX Environment, 3rd edition, Addison-Wesley Professional Computing Series,2013
2. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne: Operating System Principles, 9th edition, Wiley-India, 2012.

Course Outcomes (COs):

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

1. Apply fundamental concepts of Unix for file management and manipulation using basic Commands (PO-1, 2, 3 PSO-2).
2. Develop programs to simulate process management activities, which include process creation, synchronization and resource allocation. (PO-1, 2, 3 PSO-2)
3. Develop the programs to demonstrate file and directory structures (PO-1, 2, 3 PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	10	CO1, CO2, CO3
Internal Test-II(CIE-II)	10	CO1, CO2, CO3
Other Components		
Continuous Assessment Project	30	CO1, CO2, CO3
The Final CIE out of 50 Marks = Marks of Continuous Assessment &Lab Record + Marks scored in Lab Test-I + Marks scored in Lab Test-II		
Semester End Examination (SEE)	50	CO1, CO2, CO3

PROJECT MANAGEMENT WITH GIT	
Course Code: CSAEC49	**Credits: 1:0:0**
Pre – requisites: Agile Methodologies, Scrum	**Contact Hours: 15L+15S**
Course Coordinator: - Uzma Sulthana	

Course Content

Unit I

Introduction to Project Management- Introduction: what is a project, what is Project Management, Project Management Software: Software Development lifecycle, Agile Frameworks: Scrum, Kanban, Crystal and Dynamic Systems Development Method.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics- Group discussion on real-life software project challenges.

Unit II

Version Control Systems (VCSs) and Git basics: About Version Control, A Short History of Git, what is Git? The Command Line, Installing Git, First-Time Git Setup, Getting Help. Git Basics: Getting a Git Repository, Recording Changes to the Repository, Viewing the Commit History, Undoing Things, working with Remotes, Tagging, Git Aliases. GitOps

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / PracticalTopics: Initialize a local repository, commit sample code

Unit III

Git Branching and Distributed Git. - Git Branching: Branches in a Nutshell, Basic Branching and Merging, Branch Management, Branching Workflows, Remote Branches, Rebasing. GitLab and GitWeb. Distributed Git: Distributed Workflows, contributing to a Project, Maintaining a Project.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation,Videos
- Lab Component / PracticalTopics: Create feature branches, merge, resolve conflicts

Unit IV

GitHub: Account Setup and Configuration, contributing to a Project, maintaining a Project, managing an organization, Scripting GitHub: Services and hooks, GitHub API: Basic Usage, commenting on an Issue, Changing the Status of a Pull Request.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation,Videos
- Lab Component / PracticalTopics: Create a project board with issues and assign tasks

Unit V

The GitHub EcoSystem: Exploring the GitHub Marketplace - Introducing the GitHub Marketplace, Listing Your App on the Marketplace. Attending Events- Exploring Types of Events, Knowing What to Expect at Events, Becoming Familiar with GitHub Events, Speaking at Events. The Parts of TENS: Ten Ways to Level Up on GitHub - GitHub Help Docs, GitHub Learning Labs, GitHub In-Person Training, Project-Specific Documentation, External Community Places, Online Coding Tutorials, Online Courses and Tutorials, Blogs and Twitter, Community Forum. Ten Ways to Improve Your Development Workflow - Drafting Pull Requests, Git Aliases, Run Tests Automatically, Take Breaks, Prototype User Interfaces, Scaffold Apps with Yeoman, Chrome Web Developer Tools, StackOverflow, Code Analysis Tools, Project Boards.

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- Pedagogy/ Course delivery tools:Chalk and talk, Power point presentation,Videos
- Lab Component / PracticalTopics: Working mini-project with a project board and commit history

Suggested Learning Resources

Text Books:

2. Scott Chacon, Ben Straub by "ProGit" Version 2.1.447, 2025-04-10
3. GitHub® For Dummies® Published by: John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030-5774,

Course Outcomes (COs):

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

1. Understand software project management practices and Agile methodologies. (PO-1,3,5,11, PSO-1,03)
2. Analyze the functions of Git and GitHub in facilitating collaborative software development (PO-1,3, 8,9,10,11 PSO-1,03)
3. Design a collaborative workflow using distributed version control that includes conflict detection and resolution protocols. (PO-1,2,3,5,8,9,10,11, PSO-1, PSO-3)
4. Apply real-world development practices by creating pull requests, managing repositories, and utilizing GitHub APIs in a team environment. (PO-1,2, 3, 4, 5, 8, 9,10, 11, PSO-1,3)
5. Utilize GitHub's marketplace and tools to improve team workflows and foster collaboration. (PO-1, 5,8,9,10,11, PSO-1,3)

Course Assessment and Evaluation:

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

Data Visualization with Python and Power BI	
Course Code: CSAEC410	**Credits: 1:0:0**
Pre – requisites: Nil	**Contact Hours: 15L+15S**
Course Coordinator: - BRUNDA G	

Course Content

Unit I

Principles & Industry Use Cases Role of data visualization in decision-making.
Industry dashboards: KPIs, scorecards, executive reports. Data types, mapping to charts, visualization ethics

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Explore datasets and critique dashboards for clarity and effectiveness.
- Link: https://cran.r-project.org/doc/contrib/Owen-TheRGuide.pdf

Unit II

Python for Data Visualization Python libraries: Pandas, Matplo tlib, Seaborn, Plotly.Interactive dashboards with Plotly/Dash. Handling real-world messy datasets from CSV/API/JSON.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Load, clean, and visualize data using Python libraries (Matplotlib, Seaborn, Plotly).
  Link: https://sphweb.bumc.bu.edu/otlt/MPH-Modules/BS/R/R-Manual/R-Manual2.html

Unit III

Power BI vs Tableau, Power BI for Business Analytics Data import, transformation (Power Query).
Building interactive dashboards: slicers, drill-through, KPIs. DAX for calculated measures, Data Modeling in Power BI.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Build interactive dashboards and perform data transformations in Power BI
- Link: https://smac-group.github.io/ds/

Unit IV

Advanced Visualization Techniques Time-series and forecasting visualization.Geospatial maps (Python Folium + Power BI). Multi-dimensional & comparative visualization. Industry case study: marketing analytics or sales dashboard.

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- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Visualize time-series, geospatial, and multi-dimensional data in Python and Power BI.
- Link: https://www.geeksforgeeks.org/predictive-analysis-in /

Unit V

Capstone Project & Portfolio Work Mini-project: Combine Python preprocessing with Power BI dashboard. Present insights as business decisions. Ethical visualization: bias, misleading charts, privacy.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, Videos
- Lab Component / Practical Topics: Develop a complete interactive dashboard and present insights from a real-world dataset
- Links: https://www.geeksforgeeks.org/predictive-analysis-in

Suggested Learning Resources

Text Books:

1. **Python for Data Analysis"** – Wes McKinney, 2nd Edition, O'Reilly, 2017.
2. **Interactive Data Visualization with Python"** – Abha Belorkar, Packt Publishing, 2021Shahababa B. (2011) ,
3. **Microsoft Power BI Cookbook"** – Brett Powell, 2nd Edition, Packt, 2018
4. **Storytelling with Data: A Data Visualization Guide for Business Professionals"** – Cole Nussbaumer Knaflic, 2nd Edition, Wiley, 2020.

Course Outcomes (COs):

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

1. Analyze datasets and choose suitable visualizations. (PO-1,2, 3 PSO-2).
2. Develop Python-based visualizations using Matplotlib, Seaborn, and Plotlpy to explore and interpret data. (PO-1, 3 PSO-2).
3. Create interactive dashboards in Power BI, incorporating data transformation, KPIs, and slicers. (PO-3,5, PSO-3).
4. Implement advanced visualizations including time-series, geospatial, and multi-dimensional charts using Python and Power BI. (PO-1,3,5, PSO-3).
5. Integrate Python preprocessing with Power BI dashboards to present actionable insights from real-world datasets. (PO-2,3,5,9, PSO-3).

Course Assessment and Evaluation

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes addressed**
Internal Test-I (CIE-I)	30	CO1, CO2 and CO3
Internal Test-II CIE-II)	30	CO3, CO4 and CO5
Average of the two CIE will be taken for 30 marks		
Other Components		
Capstone Project	20	CO1, CO2, CO3, CO4 and 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 –I		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	50	CO1, CO2, CO3, CO4 and CO5

ADDITIONAL MATHEMATICS – II	
Course Code: AM41	**Credits: 0:0:0**
Pre – requisites: Nil	**Contact Hours: 45**
Course Coordinator: Dr. Veena B N	

Course Content

Unit I

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

- Pedagogy/Course delivery tools: Chalk and talk
- 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.