RAMAIAH
Institute of Technology

CURRICULUM

Outcome Based Education

(Effective from the Academic Year 2023 – 2024)

ELECTRONICS AND COMMUNICATION ENGINEERING

III & IV SEMESTER B.E.

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

About the Institute

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

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

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

About the Department

The Department of Electronics and Communication was started in 1975 and has grown over the years in terms of stature and infrastructure. The department has well equipped simulation and electronic laboratories and is recognized as a research center under VTU. The department currently offers a B. E. program with an intake of 120, and two M. Tech programs, one in Digital Electronics and Communication, and one in VLSI Design and Embedded Systems, with intakes of 30 and 18 respectively. The department has a Center of Excellence in Food Technologies sponsored by VGST, Government of Karnataka. The department is equipped with numerous UG and PG labs, along with R & D facilities. Past and current research sponsoring agencies include DST, VTU, VGST and AICTE with funding amount worth Rs. 1 crore. The department has modern research ambitions to develop innovative solutions and products and to pursue various research activities focused towards national development in various advanced fields such as Signal Processing, Embedded Systems, Cognitive Sensors and RF Technology, Software Development and Mobile Technology.

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 evolve into a department of national and international repute for excellence in education and cutting-edge research in the domain of Electronics and Communication Engineering.

MISSION OF THE DEPARTMENT

The department will continuously strive to

1. Provide a world-class learning environment that caters to local and global technological and social requirements
2. Initiate research collaborations with academia and industries to perform cutting edge research leading to socio-technological innovations
3. Develop skills for pursuing innovation and entrepreneurial ventures for graduating engineers

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PEO1: Acquire knowledge and skills to be employed as successful professionals in their chosen careers

PEO2: Emerge as technologists, researchers, and entrepreneurs through lifelong learning

PEO3: Demonstrate social, ethical, and leadership skills

PROGRAM OUTCOMES (POs):

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1: Circuit Design Concepts: Apply basic and advanced electronics for implementing and evaluating various circuit configurations.

PSO2: VLSI and Embedded Domain: Demonstrate technical competency in the design and analysis of components in VLSI and embedded domains.

PSO3: Communication Theory and Practice: Possess application level knowledge in theoretical and practical aspects required for the realization of complex communication systems.

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

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

SCHEME OF TEACHING III SEMESTER

SI. No.	Course Code	Course Title	Category	Credits				Contact Hours
				L	T	P	Total	
1.	EC31	Transform Techniques and Linear Programming (Maths dept)	BSC	2	1	0	3	3
2.	EC32	Data Structures using C++	IPCC	3	0	1	4	5
3.	EC33	Analog Electronics Circuits	PCC	2	1	0	3	4
4.	EC34	Network Analysis & Control Systems	PCC	2	1	0	3	4
5.	EC35	Digital Design with HDL	PCC	3	0	0	3	3
6.	ECL36	Analog Electronics Lab	PCC	0	0	1	1	2
7.	ECL37	Digital Design & HDL Lab	PCC	0	0	1	1	2
8.	UHV38	Universal Human Value Course	UHV	2	0	0	2	1
9.	ECAEC39	Ability Enhancement Course-III	AEC	1	0	0	1	2
			Total	**15**	**3**	**3**	**21**	
10.	PE83	Physical Education		NCMC	All students have to register compulsorily for any one of the courses with the concerned coordinator (Yoga Teacher/ Physical Education Director/ NSS Coordinator) in the beginning of the III semester. Attending the registered course from III to VIII semesters. Qualifying is mandatory for the award of the degree.			
	YO83	Yoga						
	NS83	NSS						
11.	AM31	Additional Mathematics - I *		NCMC	0	0	0	3

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

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

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

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

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

***Lateral Entry Students:**

The Non-Credit Mandatory Course, Inter/Intra Institutional Internship: All the students admitted under the lateral entry category shall have to undergo a mandatory summer Internship of 02 weeks which is an NCMC course, during the intervening

vacation of the III and IV semesters. Summer Internship shall include Inter / Intra Institutional activities. A Viva-voce examination shall be conducted during the IV semester. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of the degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete during subsequent examination after satisfying the internship requirements during subsequent semesters.

*** Lateral Entry Students:**

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

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

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

SCHEME OF TEACHING IV SEMESTER

SI. No.	Course Code	Course Title	Category	Credits				Contact Hours
				L	T	P	Total	
1.	EC41	Numerical Methods and Probability Models	BSC	2	1	0	3	3
2.	EC42	Engineering Electromagnetics	IPCC	3	0	1	4	5
3.	EC43	Communication System-I	PCC	2	1	0	3	4
4.	EC44	Microprocessors	PCC	3	0	0	3	3
5.	EC45	Signal Processing	PCC	3	0	0	3	3
6.	ECL46	Communication System Lab-I	PCC	0	0	1	1	2
7.	ECL47	Microprocessors Lab	PCC	0	0	1	1	2
8.	ECL48	Signal Processing Lab	PCC	0	0	1	1	2
9.	ECAEC49	Ability Enhancement Course-IV	AEC	1	0	0	1	1
10.	INT410	Inter/ Intra Institutional Internship	NCMC	0	0	0	0	-
			Total	**14**	**2**	**4**	**20**	
11.	AM41	Additional Mathematics II *****	NCMC	0	0	0	0	3

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

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

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

*** Lateral Entry Students:**

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

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

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

III SEMESTER

TRANSFORM TECHNIQUES AND LINEAR PROGRAMMING	
Course Code: EC31	**Credits: 2:1:0**
Pre – requisites: Nil	**Contact Hours: 28L+14T**
Course Coordinator: Monica Anand & Uma M.	

Course Content

Unit I

Laplace Transform: Definition, Transform of standard functions, Properties of Laplace transforms, Existence conditions, Transforms of derivatives, Integrals, Multiplication by t^n, Division by t, Evaluation of integrals by Laplace transforms and Transform of Periodic function.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111/105/111105134/
- https://a.impartus.com/ilc/#/course/59742/295

Unit II

Applications of Laplace Transform: Unit–step function, Unit–impulse function. Inverse transforms, Convolution Theorem, Solution of linear differential equations and Simultaneous linear differential equations using Laplace transforms. Engineering applications.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111/105/111105134/
- https://a.impartus.com/ilc/#/course/59742/295

Unit III

Fourier Series: Periodic functions, Dirichlet's conditions, Fourier series of periodic functions of period 2π and arbitrary period, complex form of Fourier series, Half range Fourier series, Practical harmonic analysis.

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

Unit IV

Fourier Transforms: Derivation of Fourier series to Fourier transforms, Infinite Fourier transform, Infinite Fourier sine and cosine transforms, Properties, Inverse transforms, Convolution theorem (without proof) and its significance, Parseval's identity (statements only), Fourier transform of derivatives and integrals, Solution of ODE's using Fourier transforms. Limitations of Fourier transform and need of Wavelet transform.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111/105/111105134/
- https://a.impartus.com/ilc/#/course/171952/703

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
- Links: https://nptel.ac.in/courses/111104027

Text Books:

1. Erwin Kreyszig –Advanced Engineering Mathematics – Wiley publication – 10th edition-2015.
2. B. S. Grewal –Higher Engineering Mathematics – Khanna Publishers – 44th edition – 2017.

References:

1. Glyn James – Advanced Modern Engineering Mathematics – Pearson Education – 4th edition – 2010.
2. Dennis G. Zill, Michael R. Cullen - Advanced Engineering Mathematics, Jones and Barlett Publishers Inc. – 3rdedition – 2009.
3. Kanti Swarup, P.K. Gupta and Man Mohan -Operations Research-Sultan Chand & Sons Publishers–2014.

Course Outcomes (COs):

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

1. Determine Laplace transform of standard functions. (PO-1, PO-2, PSO-1, PSO-3)
2. Solve initial and boundary value problems using Laplace transforms. (PO-1, PO-2, PSO-1, PSO-3)
3. Construct the Fourier series expansion of a function/tabulated data. (PO-1, PO-2, PSO-1, PSO-3)
4. Evaluate Fourier transforms of functions and use it to solve ODE's. (PO-1, PO-2, PSO-1, PSO-3)
5. Formulate and solve a simple linear programming problem. (PO-1, PO-2, PSO-1, PSO-3)

Course Assessment and Evaluation:

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

DATA STRUCTURES USING C++	
Course Code: EC32	**Credits: 3:0:1**
Pre – requisites: Fundamentals of Computing	**Contact Hours: 42L+14P**
Course Coordinator: Lakshmi Shrinivasan	

Course Content

Unit I

Classes and Objects: Introduction to OOPS, Objects as Data types, Constructors, Destructors.

Operator Overloading & Friend Functions: Overloading of Unary Operators, Binary Operators, Friend Functions

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://onlinecourses.swayam2.ac.in/cec22_cs19/preview
  http://103.170.244.45/~electronics/3%20SEMESTER

Unit II

Inheritance and Polymorphism: Inheritance, Types of Inheritances, Derived Class and Base Class, Overriding member functions, Scope resolution, Virtual Functions, Pure Virtual Functions.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://onlinecourses.swayam2.ac.in/cec22_cs19/preview
  http://103.170.244.45/~electronics/3%20SEMESTER

Unit III

Stacks: Definition, Representation, Basic operations of stack (PUSH and POP) and its implementation, Applications of Stack: Conversion from Infix to Postfix, Evaluation of Postfix expression.

Queues: Definition, Representation, Primitive operations of queue and its implementation, Circular queues and Priority queues.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://onlinecourses.swayam2.ac.in/cec22_cs19/preview
  http://103.170.244.45/~electronics/3%20SEMESTER

Unit IV

Linked Lists: Representation and implementation of operations (Insertion, Deletion and Search) of Singly, Doubly and Circular Linked Lists.

Applications: Implementation of stack and queue using lists.

Queues: Definition, Representation, Primitive operations of queue and its implementation, Circular queues and Priority queues.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://onlinecourses.swayam2.ac.in/cec22_cs19/preview
  http://103.170.244.45/~electronics/3%20SEMESTER

Unit V

Trees: Basic terminologies of binary trees, Binary Tree Traversal & its operations, Binary Search Trees (Insertion and Deletion operations).

Graphs: Basic concepts, operations (insert and delete vertex, add and delete edge), traverse graph (Depth-first traversal), Graph storage structures (Adjacency matrix), Networks: minimum spanning tree (Prim's algorithm), shortest path algorithm (Dijkstra's).

Sorting and Searching: Sort concepts, selection sort (straight selection sort), insertion sort (straight insertion sort), searching (sequential and binary search).

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://onlinecourses.swayam2.ac.in/cec22_cs19/preview
  http://103.170.244.45/~electronics/3%20SEMESTER

PRACTICAL COMPONENT OF IPCC

Using suitable software programming tool, demonstrate the operation of the following programs:

Sl. No.	Experiments
1.	Introduction to C++ programming
2.	Programs to implement Classes, objects and nesting of membership functions
3.	Programs on Inline and friend functions
4.	Programs on constructor, destructor and inheritance concepts.
5.	Programs on multiple inheritance and virtual functions.
6.	Programs on operations of stacks.
7.	Programs on applications of stacks.
8.	Programs to implement the operations of queues.
9.	Programs on operations of singly & circular linked lists.
10.	Programs on operations of Doubly linked lists.
11.	Programs to implement stack, queues and applications using linked lists.
12.	Programs on operations of trees, sorting and searching.

Text Books:

1. E Balagurusamy, "Object Oriented Programming with C++", 7th Edition, TMH, 2018.
2. D.S.Malik, "Data Structures using C++", 2nd Edition, Cengage Learning, 2003.
3. Richard F. Gilberg, Behrouz A. Forouzan, "Data Structures A Pseudocode Approach with C++", 2nd Edition, Cengage Learning India Pvt. Ltd. 2008.

Reference Books:

1. Sourav Sahay, "Object Oriented Programming Using C++", 2nd Edition, Oxford University Press, 2013.
2. Robert Lafore, "Object-Oriented Programming in C++", 4th Edition, Sams Publishing, 2002.

Course Outcomes (COs):

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

1. Illustrate the concept of operator overloading, constructor & destructor using relevant programming examples. (PO-1, PO-2, PO-3, PO-5, PO-12, PSO-2)
2. Apply the concept of inheritance in solving different application based programs. (PO-1, PO-2, PO-3, PO-5, PO-12, PSO-2)
3. Implement Stack & Queue data structure and its applications. (PO-1, PO-2, PO-3, PO-5, PO-12, PSO-2)
4. Develop different types of linked lists data structure**.** (PO-1, PO-2, PO-3, PO-5, PO-12, PSO-2)
5. Develop algorithms to solve different problems using Graph and Tree techniques (PO-1, PO-2, PO-3, PO-5, PO-12, PSO-2)

Course Assessment and Evaluation:

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

ANALOG ELECTRONIC CIRCUITS	
Course Code: EC33	**Credits: 2:1:0**
Pre – requisites: Basic Electronics	**Contact Hours: 28L+14T**
Course Coordinator: M. Nagabushanam	

Course Content

Unit I

BJT AC analysis: Hybrid equivalent model, Complete Hybrid model (calculation of A_I, A_V, R_i, R_o) Discussion of numericals on CE configuration.

Feedback and Oscillator circuits: Feedback concepts, Feedback connection types, Effect of feedback connection on input and output impedance, Effect of negative feedback on gain and bandwidth, Practical feedback circuit using BJT (Voltage series only).Phase shift oscillator, tuned oscillators (Hartley and Colpitts oscillators)(Qualitative analysis).

- Pedagogy / Course delivery tools: Chalk, Power point Presentation and talk
- Links: https://a.impartus.com/ilc/#/course/107619/533

Unit II

Power Amplifiers: Introduction and amplifier types, Transformer – Coupled class A Amplifier, Transformer – coupled Push – Pull circuits, Complementary –Symmetry Circuits, Amplifier distortion, Class C Amplifier.

FET Biasing: Self bias configuration (with numerical) voltage divider biasing.

- Pedagogy / Course delivery tools: Chalk, Power point Presentation and talk
- Links: https://a.impartus.com/ilc/#/course/107619/533

Unit III

FET Amplifiers: JFET/MOSFET Small Signal model, self-bias configuration, voltage divider configuration, source follower (CD configuration), designing of FET Amplifiers.

- Pedagogy / Course delivery tools: Chalk, Power point Presentation and talk
- Links: https://a.impartus.com/ilc/#/course/107619/533

Unit IV

Operational amplifier: Introduction, block diagram and parameters definition. Op-amp applications: Difference amplifier, instrumentation amplifier. Sample and Hold circuit, Active filters-LP, HP, BP, BR.

- Pedagogy / Course delivery tools: Chalk, Power point Presentation and talk
- Links: https://a.impartus.com/ilc/#/course/96234/452

Unit V

Op-amp comparator: Zero crossing detectors and Schmitt trigger-inverting mode.
Converter: A/D – Successive approximation, flash ADC, D/A - Weighted R-2R ladder DAC
555Timer: Astable and Monostable multivibrator operation

- Pedagogy / Course delivery tools: Chalk, Power point Presentation and talk
- Links: https://a.impartus.com/ilc/#/course/96234/452

Text Books:

1. Robert L. Boylestad and Louis Nashelsky**,** "Electronic Devices and Circuit Theory", 11th Edition, PHI, 2019.
2. D. Roy Choudhury, Shail B Jain," Linear Integrated Circuits", 4th Edition, New Age International limited, 2019

Reference Books:

1. Adel S. Sedra & Kenneth C. Smith, "Micro Electronic Circuits", 7th Edition, Oxford University Press, 2017.
2. Jacob Millman, Christos C Halkias & Satyabrata Jit, "Millman's Electronic Devices and Circuits", 2nd Edition, TMH, 2010.

Course Outcomes (COs):

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

1. Analyze BJT amplifiers with hybrid model and illustrate feedback circuit. (PO – 1, 2, 3, 8 PSO - 1)
2. Describe the power amplifiers and FET biasing circuits. (PO – 1, 2, 8,10 PSO - 1)
3. Analyze small signal model of FET amplifiers. (PO – 1, 2,3,8, PSO - 1)
4. Design instrumentation amplifier and first order filter circuits using operational amplifier**.** (PO – 1, 2, 3, 8. PSO - 1)
5. Understand the concept of comparators, converters and 555-timer circuits. (PO – 1, 2, 8, 10 PSO - 1)

Course Assessment and Evaluation:

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

NETWORK ANALYSIS & CONTROL SYSTEMS	
Course Code: EC34	**Credits: 2:1:0**
Pre – requisites: Engineering Mathematics	**Contact Hours: 28L+14T**
Course Coordinator: Sadashiva Chakrasali	

Course Content

Unit I

Introduction: Ohm's law, nodes, branches and loops, Kirchoff's Laws, Series and Parallel connections of impedances, Wye - Delta transformations, Nodal analysis, Mesh analysis.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: http://a.impartus.com/ilc/w/v/VQSy

Unit II

Mathematical modeling of Linear Systems: Review of Laplace Transforms, Introduction, Basic theorems, Inverse Laplace transforms using PFE, Transfer functions, Block diagram reduction.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://a.impartus.com/ilc/#/course/96235/452

Unit III

Signal flow graphs and **Time response Analysis:** Transfer function Analysis using Maison's Gain Formula, Time response of first order systems and 2nd order systems, Steady state errors and Error Constants.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://a.impartus.com/ilc/#/course/96235/452

Unit IV

Stability Analysis: The concept of Stability, Necessary conditions for stability, Routh – Hurwitz Criterion, Root Locus.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://a.impartus.com/ilc/#/course/96235/452

Unit V

Frequency Response Analysis: Introduction, Bode diagrams, assessment of stability using Bode plots.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://a.impartus.com/ilc/#/course/96235/452

Text Books:

1. C. K. Alexander, M. N. O. Sadiku, "Fundamentals of Electric Circuits", 5th Edition, Tata McGraw-Hill, 2015.
2. J. Nagrath and M. Gopal, "Control System Engineering", 6th Edition, New Age International Publishers, 2017.

Reference Books:

1. M. E. Van Valkenberg, "Network Analysis", 3rd Edition, Pearson/Prentice Hall, 2019.
2. Ajit. K. Mandal, "Introduction to Control Engineering Modeling, Analysis and Design", 2nd Edition, New Age International Publishers, 2012.
3. Dhanesh N. Manik, "Control Systems", 1st Edition, Cengage Learning, 2012.

Course Outcomes (COs):

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

1. Apply Kirchoff's Voltage and Current laws to linear electrical circuits and equivalent linear circuits of semiconductor devices. (PO-1, PO-8, PSO-1)
2. Determine the transfer functions of the given electrical and electronic circuits. (PO-1, PO-8, PSO-1)
3. Draw the signal flow graph and find the transfer function of a given linear system and also to find time response of the various linear systems. (PO-1, PO-8, PSO-1)
4. Analyze the linear system stability using Routh Hurwitz criterion and root locus. (PO-1, PO-8, PSO-1)
5. Analyze the linear system stability using frequency responses of the systems. (PO-1, PO-8, PSO-1)

Course Assessment and Evaluation:

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

DIGITAL DESIGN WITH HDL	
Course Code: EC35	**Credits: 3:0:0**
Pre – requisites: Basic Electronics	**Contact Hours: 42L+14T**
Course Coordinator: Reshma Verma	

Course Content

Unit I

Logic Design Fundamentals: Gate-Level Minimization: Introduction, The K-Map Method, Four- Variable K-Map, Product-of-Sums Simplification, Don't-Care Conditions, NAND and NOR Implementation, Other Two-Level Implementations, Exclusive-OR Function.

Hardware Description Languages (HDL~~S~~): Introduction to HDLs, Design Encapsulation, Truth Tables in HDLS.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://a.impartus.com/ilc/#/course/591142/1030
  https://nptel.ac.in/courses/ 117106011

Unit II

Combinational Logic: Introduction, Combinational Circuits, Analysis of Combinational Circuits, Design Procedure, Binary Adder–Subtractor, Decimal Adder, Binary Multiplier, Magnitude Comparator, Decoders, Encoders, Multiplexers.

HDL Models: Combinational Circuits, Behavioral Modeling, Writing a Test bench, Logic Simulation.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/11710611
  https://a.impartus.com/ilc/#/course/591142/1030

Unit III

Sequential Circuits: Synchronous Sequential Logic: Introduction, Sequential Circuits Storage Elements: Latches, Flip-Flops, Analysis of Clocked Sequential Circuits, Synthesizable HDL Models of Sequential Circuits

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/117106011
  https://a.impartus.com/ilc/#/course/591142/1030

Unit IV

Registers and Counters: Registers: Shift Registers, Ripple Counters, Synchronous Counters, Other Counters (Counters with unused states, Ring Counters, Johnson Counters), HDL Models of Registers and Counters

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/117106011
  https://a.impartus.com/ilc/#/course/591142/1030

Unit V

Memory and Programmable Logic: Random-Access Memory, Memory Decoding (Internal construction), Read-Only Memory, Combinational PLDs (Programmable Logic Array, Programmable Array Logic)

Design at the Register Transfer Level: Introduction, Register Transfer Level (RTL) Notation RTL Descriptions.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/117106011

Text Books:

1. M. Morris Mano, Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog" 6th Edition, Pearson Education, 2017

Reference Books:

1. Michael D Ciletti, "Advanced Digital Design with Verilog HDL", 2nd Edition, Pearson Education, 2018
2. John F Wakerly - Digital design principles and practices with Verilog, 5th Edition, Pearson education. 2018.
3. Samir Palnitkar- VERILOG HDL-A Guide to digital design and synthesis-, 2nd Edition, Pearson education. 2003

Course Outcomes (COs):

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

1. Understand the basics of HDL and reduction of logic functions using simplification techniques (PO-1, PO-2, PO-5, PO-10, PSO-1, PSO-2)
2. Design combinational circuits and test using HDL models. (PO-1, PO-2, PO-3, PO-5, PSO-1, PSO-2)
3. Design, analyse sequential circuits and test using HDL models. (PO-1, PO-2, PO-3, PO-5, PSO-1, PSO-2)
4. Design Counters & Registers and using HDL, verify the functionality. (PO-1, PO-2, PO-3, PO-5, PSO-1, PSO-2)
5. Implement logic functions using combinational PLDs (PO-1, PO-2, PO-3, PO-5, PSO-1, PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO1, CO2
Internal test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other components		
Project	20	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

ANALOG ELECTRONICS CIRCUITS LABORATORY	
Course Code: ECL36	**Credits: 0:0:1**
Pre – requisites: Nil	**Contact Hours: 14 Sessions**
Course Coordinator: M. Nagabhushanam & Punya Prabha	

Course Content

List of Experiments

A. Hardware Experiments

1. Study of input/output characteristics and determine the h-parameters of CE configuration
2. Study of drain /transfer characteristics and determine parameters of N-channel MOSFET
3. Design and test RC Phase Shift oscillator for the specified frequency
4. Design and test Class B push-pull power amplifier
5. Design of inverting Schmitt trigger circuit using Op-amp
6. Design of first order LPF and HPF active filters

B. Simulation Experiments

1. Design and Test RF oscillators (i) Hartley (ii) Colpitts
2. Design a voltage series feedback amplifier, Compare the parameters with and without feedback
3. Design and test Class A power amplifier using BJT.
4. Design and test first order BPF and BEF active filters
5. Design and test R-2R D/A convertor.
6. Design and test Astable and Monostable multivibrators using IC 555

Text Books:

1. Robert L. Boylestad and Louis Nashelsky**,** "Electronic Devices and Circuit Theory", 11th Edition, PHI, 2019.
2. D. Roy Choudhury, Shail B Jain," Linear Integrated Circuits", 4th Edition, New Age International limited, 2019.

Reference Books:

1. Adel S. Sedra and Kenneth C. Smith, "Micro Electronic Circuits", 7th Edition, Oxford University Press, 2017.

Course Outcomes (COs):

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

1. Calculate the parameters from the characteristics of BJT/MOSFET. (PO-1, PO-2, PO-8, PSO-1)
2. Design feedback and oscillator circuits using BJT. (PO-1, PO-2, PO-3, PO-5, PO-8, PSO-1)
3. Illustrate class A and B power amplifiers using BJT. (PO-1, PO-2, PO-3, PO-5, PO-8, PSO-1)
4. Design Schmitt trigger and filter circuits using Op-amp. (PO-1, PO-2, PO-3, PO-5, PO-8, PSO-1, PSO-3)
5. Design DAC and multivibrators (PO-1, PO-2, PO-3, PO-5, PO-8, PSO-1, PSO-3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course outcomes addressed**
Internal test	20	CO1, CO2, CO3, CO4, CO5
Other components		
Record (10 marks)	10	CO1, CO2, CO3, CO4, CO5
Conduction (10 marks)	10	CO1, CO2, CO3, CO4, CO5
Observation (10 marks)	10	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	50	CO1, CO2, CO3, CO4, CO5

DIGITAL DESIGN AND HDL LABORATORY	
Course Code: ECL37	**Credits: 0:0:1**
Pre – requisites: Basic Electronics	**Contact Hours: 14 Sessions**
Course Coordinator: Reshma Verma, Pavitha U S, C Sharmila Suttur	

Course Content

List of Experiments

1. (i) Realizing basic gates using universal NAND gates (ii) Implement the Boolean function using NOR gate and verify the truth table (iii) Gray code to binary converter
2. Decoder implementation (i) 74155 decoder IC and external NAND gates (ii) BCD to seven segment decoder
3. HDL: Gate level modeling with Test bench function (i) Half Adder and Full Adder (ii) 2 – 4-line decoder iii) 4 to 1 Mux
4. Multiplexers and Demultiplexers (i) IC 74153 – Implementing functions using mux (ii) Full adder with mux (iii) IC 74139 – Demultiplexer
5. HDL: Data flow modeling with Test bench (i) BCD to Excess 3 converter (ii) Realization of 4:1 mux using conditional operator (iii) 4-bit adder
6. Adders (i) Adder – Subtractor using IC 7483 (ii) Magnitude Comparator
7. HDL: Structural modeling with test bench (i) Realization of 16:1 mux using 4:1 mux hierarchical model (ii) Realization of 4-bit ripple carry adder using full adders
8. Counters (IC 7476 and external gates) (i) Ripple counter using IC7476 (ii) Asynchronous decade counter using IC 7490
9. Counters (IC 7476 and external gates) i) Synchronous Counter ii) Presettable counters (74192)
10. HDL: Behavioral modeling (i) 3:8 encoders with enable (with and without priority) (ii) JK flip flop (iii) D-type positive-edge-triggered flip-flop with asynchronous and direct inputs (iv) 4-bit BCD counter with asynchronous reset
11. Shift registers (IC 74195) (i) Left/Right shift register (ii) Ring counter/Feedback shift register
12. Programming RAM using IC 6116

- Pedagogy / Course delivery tools: Chalk and talk
- Links virtual labs: https://dld-iitb.vlabs.ac.in
- https://de-iitr.vlabs.ac.in/
- https://de-iitg.vlabs.ac.in/
- http://vlabs.iitkgp.ac.in/

Text Book:

1. M. Morris Mano, Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog" 6th Edition, Pearson Education, 2017

References:

1. Michael D Ciletti, "Advanced Digital Design with Verilog HDL", 2nd Edition, Pearson Education, 2018
2. Samir Palnitkar- VERILOG HDL-A Guide to digital design and synthesis-, 2nd Edition, Pearson education. 2003.

Course Outcomes (COs):

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

1. Design combinational logic circuits using gates and MSI ICs. (PO-1, PO-2, PO-5, PO-9, PO-10, PSO-1, PSO-2)
2. Employ digital design tools for HDL simulation and test combinational circuits to verify the functionality. (PO-1, PO-3, PO-5, PO-9, PO-10, PSO-1, PSO-2)
3. Implement sequential logic circuits using MSI ICs. (PO-1, PO-2, PO-3, PO-5, PO-9, PO-10, PSO-1, PSO-2)
4. Design and simulate sequential logic circuits in behavioral modeling of HDL. (PO-1, PO-2, PO-3, PO-5, PO-9, PO-10, PSO-1, PSO-2)
5. Implement Read and Write operations using Memories (PO-1, PO-2, PO-3, PO-5, PO-9, PO-10, PSO-1, PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course outcomes addressed**
Internal test	20	CO1, CO2, CO3, CO4, CO5
Other components		
Record (10 marks)	10	CO1, CO2, CO3, CO4, CO5
Conduction (10 marks)	10	CO1, CO2, CO3, CO4, CO5
Observation (10 marks)	10	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	50	CO1, CO2, CO3, CO4, CO5

UNIVERSAL HUMAN VALUE COURSE	
Course Code: UHV38	**Credits: 2:0:0**
Pre – requisites: Nil	**Contact Hours: 42L**
Course Coordinator:	

Course content

Unit I

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

1. Understanding the need, basic guidelines, content and process for Value Education
2. Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Lab component / Practical Topics: Survey/polls for self-exploration
- Links: Holistic Development and Role of Education https://youtu.be/sGZtTPe-lhQ

Unit II

Understanding Harmony in the Human Being - Harmony in Myself!

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

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

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

Links: Harmony in Human Being- Self https://youtu.be/83oGJ4oDeIg

Links: Harmony between Self and Body Prosperity https://youtu.be/aJ_BU2OgpKs

Unit III

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

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

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

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Lab component / Practical Topics: Survey/polls for self-exploration
- Links: Harmony in Family- Trust https://youtu.be/F2KVW4WNnS8

Links: Harmony in family- Respecthttps://youtu.be/iLqNRPuv0_8

Links: Harmony in family- Other Feeling Justice https://youtu.be/TcYJB7reKnM

Links: Harmony in the Society https://youtu.be/BkWgFinrnPw

Unit IV

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

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfillment among the four orders of nature-recyclability and self-regulation in nature

3. Understanding Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all-pervasive space
4. Holistic perception of harmony at all levels of existence

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

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

Unit V

Implications of the above Holistic Understanding of Harmony on Professional Ethics

- Natural acceptance of human values
- Definitiveness of Ethical Human Conduct
- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
- Competence in professional ethics:

A. Ability to utilize the professional competence for augmenting universal human order
B. Ability to identify the scope and characteristics of people-friendly and eco- friendly production systems,
C. Ability to identify and develop appropriate technologies and management patterns for above production systems.
    - Case studies of typical holistic technologies, management models and production systems
    - Strategy for transition from the present state to Universal Human Order:

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

Suggested Learning Resources:

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

Text Books:

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

Reference Books:

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

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw
2. https://www.youtube.com/watch?v=P4vjfE-YnVk&list=PLWDeKF97v9SP7wSlapZcQRrT7OH0ZlGC4
3. **Course handouts:** https://drive.google.com/drive/folders/1zioX_4L2fCNX4Agw282PN86pcZZT3Osr?usp=sharing
4. **Presentation slides:** https://drive.google.com/drive/folders/1rMUKh1s0HPRBlpp_b1mpS-duNRcwS6YH?usp=sharing

Course Outcomes (COs):

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

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

Course Assessment and Evaluation:

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

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

Course content

Course Learning Objectives:

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

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

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

Football	16 x 4 = 64	**Note: Students should bring their own sports attires**
Hockey	16 x 4 = 64	
Cricket	16 x 4 = 64	

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

Session 1

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

Session 2

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

Session 3

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

Course Outcomes (COs):

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

Course Assessment & Evaluation:

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

YOGA	
Course Code: YO83	**Credits: NCMC**
Pre – requisites: Nil	
Course Coordinator: Hari Chandra B P & Parimala P	

Course content

Course Learning Objectives:

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

Course Content

Introduction: Definition of yoga, benefits, astangas of yoga, Relevance of yoga and yoga-research in modern times. **Asanas:** Kriyathmakachalanas, Suryanamaskar, Superbrain yoga, Vrikshasana, Trikonasana, Veerabhadrasana, Paschimotasana, Purvothanasana, Bharadwajasana, Amruthasana, Parivruttha Trikonasana, Parsvakonasana, Ustrasana, Padmasana, Jaaanushirshasana, Navasana, Ardhachakrasana, Ardhakatichakrasana, Jataraparivarthanasana, Sethubandasana, Sarvangasana, Mathyasana, Dhanurasana, Shirshasana. **Pranayamas:** Anuloma-Viloma, Suryanuloma, Chandranuloma, Brahmari, Suryanbedhana, Chandrabedhana, Sheetali, Seethkari, Sadantha, bastrika.**Mudras:** Chinmudra-Jnanamudra, Praana mudra, panchaprana mudras, panchabhoota mudras, Pruthvi mudra, Shoonya mudra, Surya mudra, Jalodharanashaka mudra, Kundalini mudra, shoonyavaayu mudra, shakti mudra, sandhi mudra, vajra mudra and garuda mudra.

Course Outcomes (COs):

At the end of the course, a student will

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

Reference books:

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

Pedagogy:

1. Chalk and talk, demonstration, videos, ppt.

Contact Sessions:

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

Online reference sources:

- Yoga for beginners part 1: https://www.youtube.com/watch?v=VwPeThpwfWI
- Yoga for beginners part 2: https://www.youtube.com/watch?v=s_pnJTcOp8A
- Suryanamaskar: https://www.youtube.com/watch?v=nUdlucNd6go&t=133s
- Yoga for anxiety and stress: https://www.youtube.com/watch?v=hJbRpHZr_d0
- Common yoga protocol: https://www.youtube.com/watch?v=Av5ib_XRKT4
- Relevance of yoga in modern times: www.youtube.com/watch?v=HUzBCts7BTo

Course Assessment & Evaluation:

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

Scheme of SEE

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

NATIONAL SERVICE SCHEME	
Course Code: NS83	**Credits: NCMC**
Pre – requisites: Nil	
Course Coordinator: Puttabore Gowda & Siddaraju C	

Course content

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: 42L**
Course Coordinator: Shashi Prabha Gogate S	

Course Content

Unit I

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

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

Unit II

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

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

Unit III

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

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

Unit IV

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

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

Unit V

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

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

Text Books:

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

Reference Books:

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

Course Outcomes (COs):

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

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

IV SEMESTER

NUMERICAL METHODS AND PROBABILITY MODELS	
Course Code: EC41	**Credits: 2:1:0**
Pre – requisites: Nil	**Contact Hours: 28L+14T**
Course Coordinator: Monica Anand & Uma M.	

Course content

Unit I

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

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

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: https://nptel.ac.in/courses/111/105/111105134/
- Impartus Recording: https://a.impartus.com/ilc/#/course/96127/452

Unit II

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

Random Variables and Discrete Probability Distributions: Random variables, Theoretical probability distributions, Mean and variance of random variables, Binomial and Poisson distributions.

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: https://nptel.ac.in/courses/111/105/111105035/
- Impartus Recording: https://a.impartus.com/ilc/#/course/96127/452
  https://a.impartus.com/ilc/#/course/619570/1030

Unit III

Continuous Probability Distributions: Uniform, Exponential, Normal and Gamma distributions.

Joint Probability Distributions: Joint and marginal probability distributions of discrete and continuous random variables, Covariance and Correlation of discrete and continuous random variables, Conditional probability distributions.

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: https://nptel.ac.in/courses/111/105/111105035/
- Impartus Recording: https://a.impartus.com/ilc/#/course/96127/452

Unit IV

Stochastic Processes: Introduction, Classification of stochastic processes, Discrete time processes, Stationary stochastic processes, Autocorrelation, Ergodicity.
Markov Chain: Probability vectors, Stochastic matrices, Regular stochastic matrices, Markov processes, Markov chains, Higher transition probabilities, Stationary distribution of regular Markov chains and absorbing states.

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: https://nptel.ac.in/courses/111103022
- Impartus Recording: https://a.impartus.com/ilc/#/course/96127/452

Unit V

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

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: https://nptel.ac.in/courses/111/105/111105035/
- Impartus Recording: https://a.impartus.com/ilc/#/course/96151/1112

Text Books:

1. Erwin Kreyszig –Advanced Engineering Mathematics – Wiley publication – 10th edition-2015.
2. B. S. Grewal – Higher Engineering Mathematics – Khanna Publishers – 44th edition – 2017.
3. Murray R Spiegel, John Schiller & R. Alu Srinivasan – Probability and Statistics – Schaum's outlines - 4nd edition-2013.

Reference Books:

1. R.E. Walpole, R. H. Myers, R. S. L. Myers and K. Ye – Probability and Statistics for Engineers and Scientists – Pearson Education – Delhi – 9th edition – 2012.
2. Glyn James – Advanced Modern Engineering Mathematics – Pearson Education – 4th edition – 2010.

Course Outcomes (COs):

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

1. Find functional values, derivatives, areas and volumes numerically from a given data. (PO-1, PO-2, PSO-1, PSO-3)
2. Fit a least squares curve to a given data, analyze the given discrete random data and its probability distribution. (PO-1, PO-2, PSO-1, PSO-3)
3. Find parameters of continuous probability distributions and calculate the marginal and conditional distributions of bivariate random variables (PO-1, PO-2, PSO-1, PSO-3)
4. Determine the parameters of stationary random processes and use Markov chain in prediction of future events. (PO-1, PO-2, PSO-1, PSO-3)
5. Choose an appropriate test of significance and make inference about the population from a sample. (PO-1, PO-2, PSO-1, PSO-3)

Course Assessment and Evaluation:

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

ENGINEERING ELECTROMAGNETICS	
Course Code: EC42	**Credits: 3:0:1**
Pre – requisites: Engineering Physics (PY15/25)	**Contact Hours: 42L + 14P**
Course Coordinator: S. Imaculate Rosaline	

Course content

Unit I

Electrostatics: Introduction to Orthogonal co-ordinate systems – Rectangular, cylindrical, spherical, Gauss's law, Concept of Divergence and its theorem (only statement). Energy and Potential: Electric potential as a function of field, Electric Potential due to point charges, Maxwell's equation for Electrostatics, Laplace and Poisson's Equation.

Interactive Lab Module 1: Concepts of Gradient, Divergence, Electrostatic Field and Potential due to Charges

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: https://onlinecourses.nptel.ac.in/noc22_ee69/course
  https://a.impartus.com/ilc/#/course/81472/295

Unit II

Magnetostatics: Ampere's circuital law, Curl, stokes' theorem, Magnetic flux density, Scalar and Vector magnetic potentials, Maxwell's Equations for Magnetostatics. Time-varying Fields and Maxwell's Equations: Faraday's law, Displacement current, Maxwell's equations for Time Varying Fields.

Interactive Lab Module 2: Concept of Curl, Magnetic Field due to Line Sources, Circular Loop in Time Varying Magnetic Field, Displacement Current.

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: https://onlinecourses.nptel.ac.in/noc22_ee69/course
  https://a.impartus.com/ilc/#/course/81472/295

Unit III

Uniform Plane Wave: Wave Equations, Plane wave propagation in Lossless Media Uniform Plane Waves, relation between E and H (only expression, no derivation), Plane Wave propagation in Loss Media, Low Loss Media and Good Conductors, Skin Depth, Poynting's theorem (Statement only).

Interactive Lab Module 3: Linking E to H, Plane Wave, Wave attenuation

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: https://onlinecourses.nptel.ac.in/noc22_ee69/course
  https://a.impartus.com/ilc/#/course/81472/295

Unit IV

Transmission Line Theory: Lumped element model for a transmission line, wave propagation on a transmission line and line equations, Lossless transmission line, Voltage reflection coefficient, Standing waves, Wave Impedance of lossless line, special cases of terminated lossless line, Smith chart: construction and applications, conventional and graphical solution of line parameters.

Interactive Lab Module 4: Transmission-Line Simulator, Wave and Input Impedance, Interactive Smith Chart.

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: https://onlinecourses.nptel.ac.in/noc22_ee69/course

http://103.170.244.45/~electronics/4%20SEMESTER/EC43_Fields,%20Lines%20and%20Waves/L1_10.5_Lumped%20Element%20circuit%20model.mp4

Unit V

Impedance Matching: Matching with lumped elements using smith chart, Single stub matching: shunt and series stubs using only Smith chart, Quarter wave transformer, Construction and field distribution of micro-strip lines.

Interactive Lab Module 5: Lumped Element Matching Design, Single-Stub Tuning Design, Quarter-Wavelength Transformer Design.

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: https://onlinecourses.nptel.ac.in/noc22_ee69/course

http://103.170.244.45/~electronics/4%20SEMESTER/EC43_Fields,%20Lines%20and%20Waves/

Text Books:

1. Fawwaz T. Ulaby, Umberto Ravaioli, "Fundamentals of Applied Electromagnetics", 7th Edition, Pearson Publications, 2014.
2. William H. Hayt Jr., John A. Buck, "Engineering Electromagnetics", 8th Edition, McGraw Hill Publications, 2010.

Reference Books:

1. Mathew N. O. Sadiku, "Elements of Electromagnetics", 7th Edition, Oxford University Press, 2021.
2. John Ryder D, "Networks, Lines and Fields", 2nd Edition, Pearson India, 2015.
3. Interactive Modules -- Java Web Start Applications

Course Outcomes (COs):

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

1. Analyze the concept of divergence, potential and significance of Maxwell's equation in Electrostatics. (PO-1, PO-2, PO-5, PO-8, PSO-1, PSO-3)
2. Explore the concept of Magnetostatics and interpret Maxwell's equations for time varying fields (PO-1, PO-2, PO-5, PO-8, PSO-1, PSO-3)
3. Illustrate the wave propagation through different media. (PO-1, PO-2, PO-5, PO-8, PSO-1, PSO-3)
4. Estimate the parameters of transmission lines analytically and graphically. (PO-1, PO-2, PO-5, PO-8, PSO-1, PSO-3)
5. Design impedance matching networks using Smith chart (PO-1, PO-2, PO-5, PO-8, PSO-1, PSO-3)

Course Assessment and Evaluation:

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

COMMUNICATION SYSTEMS-I	
Course Code: EC43	**Credits: 2:0:1**
Pre – requisites: Transform Techniques and Linear Programming EC31	**Contact Hours: 28L+14T**
Course Coordinator: Lakshmi S	

Course content

Unit I

Amplitude Modulation and Double Side-band Suppressed Carrier Modulation: Introduction to AM: Time domain description, Frequency domain description. Generation of AM wave: Square law modulator, switching modulator. Detection of AM waves: envelope detector. Time domain description of DSBSC, Frequency domain representation, Generation of DSBSC waves: ring modulator, coherent detection of DSBSC modulated waves.

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: https://nptel.ac.in/courses/117105143
  https://a.impartus.com/ilc/#/course/2126912/1174

Unit II

Angle Modulation (FM): Basic definitions, FM, narrow band FM, wideband FM, transmission bandwidth of FM waves. Generation of Wide Band FM waves. Demodulation of FM waves: PLL, Pre-emphasis and De-emphasis in FM.

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: https://nptel.ac.in/courses/117105143
  https://a.impartus.com/ilc/#/course/2126912/1174

Unit III

Noise Basics and Noise in Continuous Wave Modulation Systems: Introduction, shot noise, thermal noise, white noise, noise equivalent bandwidth, noise figure, equivalent noise temperature, cascade connection of two port networks, receiver model, noise in DSBSC receivers and in standard AM receivers.

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: https://nptel.ac.in/courses/117105143
  https://a.impartus.com/ilc/#/course/2126912/1174

Unit IV

Signal Sampling: Basic signal processing operations in digital communication, sampling principles, Sampling Theorem, Practical aspects of sampling and signal recovery, PAM, TDM

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: https://nptel.ac.in/courses/117105143
  https://a.impartus.com/ilc/#/course/2126912/1174

Unit V

Waveform Coding Techniques: PCM block diagram, Different quantization techniques, SNR in PCM, DPCM, Delta Modulation.

Base Band Shaping for Data Transmission: Line Codes and their power spectra.

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: https://nptel.ac.in/courses/108102120
  https://a.impartus.com/ilc/#/course/119502/593

Text Books:

1. Simon Haykin, Michael Moher, "Introduction to Analog and Digital Communication", 2nd Edition, Wiley India Pvt. Ltd., 2012.
2. H. Taub, D. L. Schilling, "Principles of Communication Systems", 2nd Edition, McGraw Hill, Reprint, 2008

Reference Books:

1. Bernard Sklar, "Digital Communications", 2nd Edition, Pearson Education, 2007.
2. B. P. Lathi and Zhi Ding, "Modern Digital and Analog Communication Systems", 4th International Edition, Oxford University Press, 2015.

Course Outcomes (COs):

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

1. Describe the generation and demodulation of AM and DSBSC systems (PO-1, PO-2, PO-3, PO-8, PSO-3)
2. Recognize the direct and indirect method of generation of FM and its detection systems (PO-1, PO-2, PO-3, PO-8, PSO-3)
3. Differentiate the noise performance of receivers systems (PO-1, PO-2, PO-3, PO-8, PSO-1, PSO-3)
4. Understand sampling techniques for Digital communication systems. systems (PO-1, PO-2, PO-3, PO-8, PSO-3)
5. Compare the performances of waveform coding techniques and line codes. systems (PO-1, PO-2, PO-3, PO-8, PSO-3)

Course Assessment and Evaluation:

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

MICROPROCESSORS	
Course Code: EC44	**Credits: 3:0:0**
Pre – requisites: Digital Design with HDL	**Contact Hours: 42L**
Course Coordinator: Flory Francis & C Sharmila Suttur	

Course content

Unit I

8086 Microprocessor and its Architecture: Introduction, internal architecture of 8086, PSW, Real mode memory addressing. Pin outs and pin functions of 8086.
Addressing Modes: Data addressing mode, Program memory addressing mode, Stack memory addressing mode.

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: https://nptel.ac.in/courses/108103157
  http://a.impartus.com/ilc/#/course/1249517/1112

Unit II

Instruction set of 8086: Data move, Arithmetic and Logic, Program control, Assembly language programming.
Modular Programming: Assembler and linker, PUBLIC & EXTRN, Assembler directives, Programs using DOS interrupts, DOS function calls.

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: https://nptel.ac.in/courses/108103157
  http://a.impartus.com/ilc/#/course/1249517/1112

Unit III

Timing and Interrupts: Bus timing, READY and wait state, Basic Interrupt Processing, Hardware Interrupts.
Memory, I/O and Peripheral Interfacing: Address decoding, memory interfacing for 8086, I/O port address decoding, Study of 8255 PPI and related programs (LED and switch interface, DAC, Stepper motor).

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: https://nptel.ac.in/courses/108103157
  http://a.impartus.com/ilc/#/course/1249517/1112

Unit IV

ARM Processor Fundamentals: ARM Architecture, Registers, current program status register, pipelining.

Interrupts and Exceptions: Interrupts and vector table, exceptions, non-nested interrupt handlers.

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: https://nptel.ac.in/courses/106105193

Unit V

ARM Instruction Set: Data Processing Instructions, Branch Instructions Load Store Instructions, Software Interrupt Instruction, Program Status Register Instructions.

THUMB Instruction set: Thumb register usage, ARM – Thumb Interworking, other branch instructions, Data Processing Instructions, Single register Load – Store Instructions, Multiple register Load Store Instructions and Stack Instructions.

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: https://nptel.ac.in/courses/106105193

Text Books:

1. Barry B Brey, "The Intel Microprocessors – Architecture, Programming and Interfacing", 8th Edition, Pearson Education, 2009
2. Andrew N. Sloss, "ARM system Developers Guide", Elsevier, 2009

Reference Books:

1. Yu Cheng Liu, Glenn A Gibson, "Microcomputer Systems 8086/8088 Family, Architecture, Programming and Design", 2nd Edition, Prentice Hall of India, July 2003.
2. A. K. Ray and K. M. Bhurchandi, "Advanced Microprocessor and Peripherals", 3rd Edition, Tata McGraw Hill, 2007
3. LPC 2148 user manual.

Course Outcomes (COs):

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

1. Describe the architecture of 8086 processors. (PO-1, PO-2, PO-10, PSO-2)
2. Apply instruction set of 8086 processors to write assembly language programs (PO-1, PO-2, PSO-2)
3. Design interfacing circuits for 8086 processors (PO-1, PO-2, PO-3, PSO-2)
4. Understand the hardware architecture of ARM Processors (PO-1, PO-2, PO-10, PSO-2)
5. Describe the instruction set of ARM Processor (PO-1, PO-2, PO-10, PSO-2)

Course Assessment and Evaluation:

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

SIGNAL PROCESSING	
Course Code: EC45	**Credits: 3:0:0**
Pre – requisites: Engineering Mathematics	**Contact Hours: 42L**
Course Coordinator: H. Mallika	

Course content

Unit I

Introduction to Signals and Systems: Discrete time signals, Discrete time systems: input output description of systems, classification of discrete time systems, resolution of a discrete time signal into impulses, response of LTI systems to arbitrary inputs (Convolution sum), properties of Convolution and the interconnection of LTI systems, causal LTI systems, stability of LTI system.

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: https://archive.nptel.ac.in/courses/117/105/117105149/
  http://a.impartus.com/ilc/#/course/59755/295

Unit II

z-Transform: z- transform, the direct z-transform. Properties of the z-transform: Linearity, shifting, scaling in z-domain, time reversal, differentiation in z-domain, convolution of two sequences. System function of a LTI system, the inverse z-transform by partial fraction expansion.

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: https://archive.nptel.ac.in/courses/117/102/117102060/
  http://a.impartus.com/ilc/#/course/59755/295

Unit III

Discrete Fourier Transform: Fourier series for discrete time periodic signals, Fourier Transform (FT) of Discrete Time Aperiodic Signals, Fourier Transform Theorems and properties: Linearity, time shifting, convolution, frequency shifting and modulation, Discrete Fourier Transform, DFT as a linear transformation, Circular convolution, Parseval's theorem, Symmetric property, Radix-2 FFT algorithm (Decimation in Time).

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: https://archive.nptel.ac.in/courses/117/102/117102060/
  https://a.impartus.com/ilc/#/course/81472/295

Unit IV

FIR Filters: Causality and its implications, Characteristics of practical frequency selective filters Design of FIR filters: Symmetric and anti-symmetric FIR filters, Design of Linear phase FIR filter using Windows. Structures for FIR Systems: Direct form structures, cascade form structures.

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: https://archive.nptel.ac.in/courses/117/102/117102060/
  https://a.impartus.com/ilc/#/course/81472/295

Unit V

IIR Filters: Characteristics of commonly used analog filters: Butterworth filters and Chebyshev filters, Frequency transformations in the analog domain, Design of analog filters. Digital IIR filter design by the Bilinear transformation. IIR filter structures: Direct form I and II.

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: https://archive.nptel.ac.in/courses/117/102/117102060/
  https://a.impartus.com/ilc/#/course/81472/295

Text Books:

1. J. G. Proakis, D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", 5th Edition, Pearson Education Asia/Prentice Hall of India, 2021.

Reference Books:

1. Alan V. Oppenheim, Alan S. Wilsky with S. Hamid Nawab, "Signals and Systems", 2nd Edition, PHI Publications, 2014.
2. Simon Haykin, Barry Van Veen, "Signals and Systems", 2nd Edition, John Wiley & Sons, 2007.
3. Lizhe Tan, Jean Jiang, "Digital Signal Processing Fundamentals and Applications", 3rd Edition, Academic Press, 2019.

Course Outcomes (COs):

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

1. Identify discrete time signals and systems and calculate the response using convolution sum. (PO-1, PO-2, PO-8, PO-10, PSO-3)
2. Classify discrete signals and systems using z-transform. (PO-1, PO-2, PO-8, PO-10, PSO-3)
3. Analyze discrete time signals by Fourier transform. (PO-1, PO-2, PO-8, PSO-3)
4. Design the coefficients of FIR filters and draw digital structures. (PO-1, PO-2, PO-3, PO-8, PO-12, PSO-3)
5. Design the coefficients of IIR filters and draw digital structures. (PO-1, PO-2, PO-3, PO-8, PO-12, PSO-3)

Course Assessment and Evaluation:

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

COMMUNICATION SYSTEMS LABORATORY-I	
Course Code: ECL46	**Credits: 0:0:1**
Pre – requisites: AEC Lab ECL36	**Contact Hours: 14**
Course Coordinator: Lakshmi S	

Course content

List of Experiments

1. Design and analysis of Class-C tuned amplifier
2. Design of standard AM generator
3. Design of AM demodulator using envelope detector
4. Generation of DSBSC using ring modulator
5. Design and analysis of Frequency Modulator
6. Design of FM demodulator using PLL
7. Testing of a Transistor mixer
8. Design and testing of Frequency division multiplexing (FDM) system
9. Design and Verification of Sampling and reconstruction systems.
10. Generation and reconstruction of a Time division multiplexing
11. Design of Pulse Code Modulator and demodulator
12. Simulation of Analog modulation techniques, Pulse modulation and Line codes

Textbooks:

1. Simon Haykin, Michael Moher, "Introduction to Analog and Digital Communication", 2nd Edition, Wiley India Pvt. Ltd., 2012.
2. George Kennedy, Bernard Davis, S R M Prasanna, "Electronic Communication Systems", 5th Edition, McGraw-Hill, 2011.

Course Outcomes (COs):

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

1. Simulate and implement modulation and demodulation circuits for AM and FM (PO-1, PO-2, PO-3, PO-5, PO-8, PO-9, PO-10, PSO-1, PSO-3)
2. Implement up and down converters using transistor mixer (PO-1, PO-2, PO-3, PO-5, PO-8, PO-9, PO-10, PSO-1, PSO-3)
3. Illustrate frequency and time division multiplexing (PO-1, PO-2, PO-3, PO-5, PO-8, PO-9, PO-10, PSO-1, PO-3)
4. Analyze of sampling theorem for continuous time signals (PO-1, PO-2, PO-3, PO-5, PO-8, PO-9, PO-10, PSO-1, PO-3)
5. Implement pulse code modulator and demodulator circuits (PO-1, PO-2, PO-3, PO-5, PO-9, PO-10, PSO-1, PO-3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course outcomes addressed**
Internal test	20	CO1, CO2, CO3, CO4, CO5
Other components		
Record, Conduction and Observation	30	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	50	CO1, CO2, CO3, CO4, CO5

MICROPROCESSORS LABORATORY	
Course Code: ECL47	**Credits: 0:0:1**
Pre – requisites: Microprocessor Lab	**Contact Hours: 14**
Course Coordinator: C Sharmila Suttur & Flory Francis	

Course content

List of Experiments

A. 8086 Assembly Language Programs (using MASM)

1. Programs involving Data Transfer Instructions
   i. Block move with and without overlapping.
   ii. Block interchange.
2. Programs involving Arithmetic Operation.
   i. 16 Bit Addition and Subtraction
   ii. Addition of N-bit multi precision numbers (N ≥ 32bits)
   iii. Multiplication of two unsigned 32- bit numbers
3. Programs involving Bit Manipulation Instructions.
   i. 2 out of 5 Codes
   ii. Find the logical 1's and 0's in the given data
4. To Find LCM, HCF and Factorial
   i. Program to find LCM of a given number
   ii. Program to find HCF of a given number
5. Program to find factorial of a given number
6. Code Conversion
   i. BCD to Hexadecimal
   ii. Hexadecimal to BCD
7. Program to perform addition and subtraction of two ASCII data
8. Program to read the password and verify using DOS Functions.

Assembly Language Programs (using ARM)

9. Program using ARM Instruction set
   i. To sort a given set of numbers in ascending order using bubble sort algorithm.
   ii. To reverse a given string and verify whether it is a palindrome or not. Display the appropriate message.
10. Program using Thumb instructions to find the Largest/ Smallest Numbers from a given array

B. Interface Experiments – 8086 Microprocessor

11. Delay calculation and generation of a square wave, triangular waveform using DAC. Display the waveform on a CRO.

12. Interface 8086 processor with 8255 PPI to rotate the stepper motor in clockwise/anticlockwise directions.

- Pedagogy / Course delivery tools: Chalk and talk.
- Links: https://nptel.ac.in/courses/106/105/106105193/

Text Book:

1. Barry B Brey, "The Intel Microprocessors – Architecture, Programming and Interfacing", 8th Edition, Pearson Education, 2009.
2. Andrew N. Sloss, "ARM system Developers Guide", 1st Edition, Elsevier, 2008.

Reference:

1. Yu Cheng Liu, Glenn A Gibson, "Microcomputer Systems 8086/8088 Family, Architecture, Programming and Design", 2nd Edition, Prentice Hall of India, July 2003.
2. K. Ray and K. M. Bhurchandi, "Advanced Microprocessor and Peripherals", 3rd Edition, Tata McGraw Hill, 2007
3. LPC 2148 user manual.

Course Outcomes (COs):

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

1. Write an assembly language program using Data transfer and Arithmetic instructions. (PO-1, PO-2, PO-3, PO-5, PO-10, PSO-2)
2. Write assembly language programs for logical operations and code conversion. (PO-1, PO-2, PO-3, PO-5, PO-10, PSO-2)
3. Illustrate programs using branch and loop instructions. (PO-1, PO-2, PO-3, PO-5, PO-10, PSO-2)
4. Write programs using ARM Instruction sets and Thumb instructions (PO-1, PO-2, PO-3, PO-5, PO-10, PSO-2)
5. Write assembly language programs to interface DAC and Stepper motor to 8086 microprocessors (PO-1, PO-2, PO-3, PO-5, PO-10, PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course outcomes addressed**
Internal test	20	CO1, CO2, CO3, CO4, CO5
Other components		
Record (10 marks)	10	CO1, CO2, CO3, CO4, CO5
Conduction (10 marks)	10	CO1, CO2, CO3, CO4, CO5
Observation (10 marks)	10	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	50	CO1, CO2, CO3, CO4, CO5

SIGNAL PROCESSING LABORATORY	
Course Code: ECL48	**Credits: 0:0:1**
Pre – requisites: Nil	**Contact Hours: 14**
Course Coordinator: Sadashiva Chakrasali	

Course content

List of Experiments

1. Signal generation: Generation various continuous and discrete time signals
2. Linear convolution: Performing Linear convolution of two sequences with different time index
3. FFT, IFFT, Circular Convolution in time domain, Linear convolution and Circular Convolution in
4. frequency domain
5. N point DFT and IDFT computation using CCS
6. Z - transform, Inverse Z - transform, impulse response of a transfer function, Pole zero location
7. Solving difference equation using Z transform
8. Design of Low pass and High pass FIR filters
9. Design of Band pass and Band reject FIR filters
10. Analog IIR filter design: Using Butterworth and Chebyshev Approximations
11. Digital IIR filter design: Design of Analog LPF, HPF, Bandpass and Bandstop Filters
12. Linear convolution using Code Composer Studio and TMS320C6748 LCDK emulator
13. Solving difference equation using Code Composer Studio and TMS320C6748 LCDK emulator

- Pedagogy / Course delivery tools: Chalk and talk.
- Links virtual labs: https://in.mathworks.com/products/signal.html
  http://vlabs.iitkgp.ernet.in/dsp/
  https://ssp-iiith.vlabs.ac.in

Text Books:

1. Dr. Shailendra Jain, "Modeling and Simulation using MATLAB-Simulink", Wiley, Second Edition, 2014.
2. J. G. Proakis, Ingle, "Digital Signal Processing using MATLAB", MGH, 2000.
3. Venkataramani and Bhaskar, "Digital Signal Processors", TMH, 2002.

Reference Books:

1. P. Ramakrishna Rao and Shankar Prakriya, "Signals and Systems", McGraw Hill EducationSecond Edition, 2013.
2. Sanjit K Mitra, "Digital Signal Processing using MATLAB", TMH, 2001.

Course Outcomes (COs):

On successful completion of the course students will be able to

1. Find output of LTI systems for given inputs (PO-1, PO-2, PO-3, PO-5, PO-9, PO-10, PSO-3)
2. Analyze frequency domain representation of signals (PO-1, PO-2, PO-3, PO-5, PO-9, PO-10, PSO-3)
3. Design and implement FIR filters for the given specifications (PO-1, PO-2, PO-3, PO-5, PO-9, PO-10, PSO-3)
4. Design and implement IIR filters for the given specifications (PO-1, PO-2, PO-3, PO-5, PO-9, PO-10, PSO-3)
5. Analyze LTI systems using CCS (PO-1, PO-2, PO-3, PO-5, PO-9, PO-10, PSO-3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course outcomes addressed**
Internal test	20	CO1, CO2, CO3, CO4, CO5
Other components		
Record (10 marks)	10	CO1, CO2, CO3, CO4, CO5
Conduction (10 marks)	10	CO1, CO2, CO3, CO4, CO5
Observation (10 marks)	10	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	50	CO1, CO2, CO3, CO4, CO5

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

ABILITY ENHANCEMENT COURSE III / IV SEMESTER	
Course Code: ECAEC39XXX/ ECAEC49XXX	**Credits: 1:0:0**
Pre – requisites: Nil	**Contact Hours: 14L**

Course content

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

Every student shall register for AEC course under the supervision of his/her proctor. For III, IV & V semester, the student shall select the Ability Enhancement Course offered by the respective department, after selection, the registration of the course has to be done by the student at his/her parent department.

DATA ANALYTICS USING EXCEL	
Course Code: ECAEC391/ ECAEC491	**Credits: 1:0:0**
Pre – requisites: Nil	**Contact Hours: 14L**
Course Coordinator: Deepali Koppad	

Course content

Unit I

Introduction to Excel: Basic Navigation Tab, Concept of Cell and Cell address, row, column concept – Selecting Columns & Rows, Changing and autofitting Column Width & Row Height, Hiding/Unhiding Columns & Rows, perform calculations by using SUM, MIN, MAX, COUNT, AVERAGE functions, perform conditional operations using SUMIF, AVERAGEIF.

- Pedagogy / Course delivery tools: PPT & Online Hands-on sessions
- Links:http://www.princeton.edu/~otorres/Excel/
- Links:https://support.microsoft.com/en-au/office/excel-video-training-9bc05390-e94c-46af-a5b3-d7c22f6990bb

Unit II

Reading and Manipulating Data: Data introduction, Currency Format – Formatting Dates, Managing Worksheets Moving, Copying, Deleting and Hiding Grouped Worksheets, manual data input, copy data, import data, sort and filter data, paste data, remove duplicates, find and replace,

- Pedagogy / Course delivery tools:PPT & Online Hands-on sessions
- Links:http://www.princeton.edu/~otorres/Excel/
- Links:https://support.microsoft.com/en-au/office/excel-video-training-9bc05390-e94c-46af-a5b3-d7c22f6990bb

Unit III

Pivot Table and Objects: Introduction to Pivot table, create pivot table, layout, options, summary of values, show values, subtotals, analyze, design, Insert text boxes and shapes – Insert images, Modify object properties, Printing a Worksheet,

- Pedagogy / Course delivery tools:PPT & Online Hands-on sessions
- Links: http://www.princeton.edu/~otorres/Excel/
- Links:https://support.microsoft.com/en-au/office/excel-video-training-9bc05390-e94c-46af-a5b3-d7c22f6990bb

Unit IV

Forecast and Charts: Introduction to Forecast, goal seeker, scenario manager, data table, forecast sheet, Create a new chart, types of charts, Resize charts, Add and modify chart elements, Apply chart layouts and styles, Move charts to a chart sheet

- Pedagogy / Course delivery tools:PPT & Online Hands-on sessions
- Links: http://www.princeton.edu/~otorres/Excel/
- Links:https://support.microsoft.com/en-au/office/excel-video-training-9bc05390-e94c-46af-a5b3-d7c22f6990bb

Unit V

Data Analysis for statistics: Scatter plots, descriptive statistics, histogram, correlation, linear regression, explanation of regression output

- Pedagogy / Course delivery tools:PPT & Online Hands-on sessions
- Links: http://www.princeton.edu/~otorres/Excel/
- Links:https://support.microsoft.com/en-au/office/excel-video-training-9bc05390-e94c-46af-a5b3-d7c22f6990bb

Text Books:

1. Wayne Winston, "Microsoft Excel Data Analysis and Business Modeling", Pearson Education 2019.
2. Michael Alexander, Richard Kusleika, John Walkenbach, Excel Bible, Wiley 2018.
3. https://www.tutorialspoint.com/data-analysis-with-microsoft-excel/index.asp
4. https://corporatefinanceinstitute.com/course/excel-data-analysis/

Course Outcomes (COs):

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

1. Understand working and use of MS-EXCEL at workplace. (POs:1, 2, 3, 5, 8, 9, 10, 11, 12)
2. Perform data analysis with formulas and functions. (POs: 1, 2, 3, 5, 8, 9, 10, 11, 12)
3. Analyze data with PivotTables and print. (POs: 1, 2, 3, 5, 8, 9, 10, 11, 12)
5. Apply tools for data visualization and forecasting. (POs: 1, 2, 3, 5, 8, 9, 10, 11, 12)
6. Analyze data for business decision making. (POs: 1, 2, 3, 5, 8, 9, 10, 11, 12)

Course Assessment and Evaluation:

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

MATLAB-SIMULINK PROGRAMMING	
Course Code: ECAEC392/ ECAEC492	**Credits: 1:0:0**
Pre – requisites: Engineering Mathematics	**Contact Hours: 14L**
Course Coordinator: H. Mallika	

Course content

Unit I

Basics of MATLAB: Fundamentals, Creating and Manipulating Arrays, Imaginary and Complex data, Accessing Data in Arrays.

- Pedagogy/Course delivery tools: PPT, Chalk and talk
- Links: https://www.tutorialspoint.com/matlab/index.htm
  https://matlabacademy.mathworks.com/

Unit II

Data Visualization: Identifying Available Vector Plot Types, Customized Annotations, Customizing, Plot Properties, Axis Control, Plotting Multiple Columns, Visualizing Matrices, Exporting Figures.

- Pedagogy/Course delivery tools: PPT, Chalk and talk
- Links: https://www.tutorialspoint.com/matlab/index.htm
- https://matlabacademy.mathworks.com/

Unit III

Dataset Representation and Manipulation: Tables of Data, Organizing Tabular, Data, Preprocessing Data.

- Pedagogy/Course delivery tools: PPT, Chalk and talk
- Links: https://www.tutorialspoint.com/matlab/index.htm
  https://matlabacademy.mathworks.com/

Unit IV

Matlab Simulink: Introduction, Blocks, Lines, Build and Simulate model, Create Subsystem.

- Pedagogy/Course delivery tools: PPT, Chalk and talk
- Links: https://www.tutorialspoint.com/matlab/index.htm
  https://matlabacademy.mathworks.com/

Unit V

Matlab Simulink Application: Time response of first and second order systems, System Analysis.

- Pedagogy/Course delivery tools: PPT, Chalk and talk
- Links: https://www.tutorialspoint.com/matlab/index.htm

Text Books:

1. R. Balaji, "Basics of MATLAB Programming", 1st Edition, Notion Press, 2020

Reference Books:

1. Dr. Shailendra Jain, "Modeling and Simulation using MATLAB - Simulink", Wiley, 2016

Course Outcomes (COs):

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

1. Create and handle different types of data. (POs – 1, 2,5, 9 & PSO – 2)
2. Visualization of the dataset. (POs – 1, 2, 5,9, 12 & PSO – 2)
3. Create and handle tables. (POs – 1, 2, 5, 9, 12 & PSO – 2)
4. Build subsystems using Simulink. (POs –1, 2, 5,9,12 & PSO – 2)
5. Analyze first and second order systems using Simulink model. (POs – 1,2, 5,9 & PSO – 2)

Course Assessment and Evaluation:

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