



RAMAIAH
Institute of Technology

CURRICULUM

**Outcome Based Education
(Academic Year 2022 – 2023)**

**ELECTRONICS AND
INSTRUMENTATION 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 15 PG programs. All these programs are approved by AICTE. All eligible UG and PG programs are accredited by National Board of Accreditation (NBA). The institute is accredited with 'A+' **grade by NAAC in March 2021** for 5 years. University Grants Commission (UGC) & Visvesvaraya Technological University (VTU) have conferred Autonomous Status to MSRIT for both UG and PG Programs since 2007. The institute is also been conferred autonomous status for Ph.D program since 2021. The institute is a participant to the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. The institute has 380 competent faculty out of which 65% are doctorates. Some of the distinguished features of MSRIT are: State of the art laboratories, individual computing facility for all faculty members, all research departments active with sponsored funded projects and more than 300 scholars pursuing Ph.D. To promote research culture, the institute has established Centre of Excellence for Imaging Technologies, Centre for Advanced Materials Technology, Centre for Antennas and Radio Frequency systems (CARFS), Center for Cyber Physical Systems, Schneider Centre of Excellence & Centre for Bio and Energy Materials Innovation. **M S Ramaiah Institute of Technology has obtained "Scimago Institutions Rankings" All India Rank 107 & world ranking 600 for the year 2022.** The Entrepreneurship Development Cell (EDC) and Section 8 company "Ramaiah Evolute" have been set up on campus to incubate startups. **M S Ramaiah Institute of Technology is recognized by Atal Ranking of Institutions on Innovation Achievements (ARIIA), MoE, Govt. of India.** MSRIT has a strong Placement and Training department with a committed team, a good Mentoring/Proctorial system, a fully equipped Sports department, large air-conditioned library with good collection of book volumes and subscription to International and National Journals. The Digital Library subscribes to online e-journals from Elsevier Science Direct, IEEE, Taylor & Francis, Springer Link, etc. MSRIT is a member of DELNET, CMTI and VTU E-Library Consortium. MSRIT has a modern auditorium and several hi-tech conference halls with video conferencing facilities. The institute has excellent hostel facilities for boys and girls. MSRIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association.

As per the National Institutional Ranking Framework (NIRF), MoE, Government of India, M S Ramaiah Institute of Technology has achieved 67th rank among 1249 top Engineering Institutions & 17th Rank for School of Architecture in India for the year 2022 and is 1st amongst the Engineering Colleges affiliated to VTU, Karnataka.

About the Department:

The Department was established in the year 1992 as Instrumentation Technology and was renamed as Electronics and Instrumentation Engineering (EIE) in the year 2014 by VTU. The department offers UG course which is recognized by AICTE and accredited by NBA, four times (up to 2022). The department is recognised as a Research Centre by VTU, Belagavi and offers Ph.D and MSc.(Engg.) by research programs. All the faculty members are doctorates and are actively engaged in R&D activities.

The department is focussed on empowering the students with technical knowledge and practical skills in the areas of Instrumentation Technology and Industrial Automation System in line with Industry 4.0. The department is equipped with modern laboratories including Allen Bradley PLCs, SCADA from Schneider Electric, Ocean Optics Optical Spectrometer and research software such as Neuroshell predictor and classifier to name a few.

The course and curriculum is basically multi-disciplinary in nature and revolves around electronics, computers and embedded systems. The focus is on the design and control of automated systems. In line with Industry 4.0 standards, the department is also focussed on offering courses on automation, bridging the gap between academia and industries. The emphasis is on hands on training with PLCs, SCADA, Robotics, Automation and IoT. With wide exposure to theory and hands-on training in the modern laboratories, the students are well equipped to get into core industries and/or higher studies in India and abroad.

Our Board of Studies involves experts from IISc, HAL, ISRO, DRDO and our alumni giving inputs to the curriculum design and modifications. The department has an MoU with Mitsubishi Electric India Private Limited, Schneider Electric India Private Limited and S M Electronic Technologies Private Limited. The department has externally funded research project and has several consultancy projects and linkages with industries. Consultancy projects are in the areas of internet of things (IoT), PLC based pneumatic and hydraulic experimental setup, low cost accessories for biomedical devices, and automation. The department also has an active membership in International Society of Automation (ISA) and the Society of Instrumentation Professionals (ISOI -IISc).

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

RIT shall meet the global socio-economic needs through

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

QUALITY POLICY

We at 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 become centre of excellence in the field of Electronics and Instrumentation Engineering for education and research.

MISSION OF THE DEPARTMENT

To empower and imbibe students with technical knowledge and practical skills in the field of Electronics and Instrumentation Engineering, enabling them to work as professionals in globally competitive environment and contribute to the society through research and higher studies.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PEO1: To analyze and solve problems in Electronics and Instrumentation Engineering related to industry and research by applying knowledge in mathematics, physical science and engineering.

PEO2: To design and commission an industrial automation system.

PEO3: To communicate effectively, work with team, practice professional ethics, and engage in lifelong learning.

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: Identify, analyze, design and implement-problems in diverse and multidisciplinary background emphasizing control and industrial automation, using modern tools.

PSO2: Understand the impact of engineering solutions in societal, environmental context and manage the projects efficiently.

PSO3: Adhere to professional ethics, lifelong learning, team building skills and communicate effectively.

SCHEME OF TEACHING

III SEMESTER

Sl. No.	Course Code	Course Name	Teaching Dept.	Category	Credits				Contact Hours
					L	T	P	Total	
1	EI31	Transform Techniques and Linear Programming	MATH	BSC	2	1	0	3	4
2	EI32	Analog Electronic Circuits	EIE	IPCC	2	0	1	3	4
3	EI33	Network Analysis	EIE	PCC	2	1	0	3	3
4	EI34	Digital System Design	EIE	PCC	3	0	0	3	4
5	EI35	Measurement and Instrumentation	EIE	PCC	3	0	0	3	3
6	EIL36	Digital System Design Lab	EIE	PCC	0	0	1	1	2
7	EIL37	Measurement and Instrumentation Lab	EIE	PCC	0	0	1	1	2
8	UHV38	Universal Human Values	EIE	UHV	2	0	0	2	2
9	HS392	Constitution of India & Professional Ethics	HSMC	HSMC	1	0	0	1	1
10	xxAEC310	Ability Enhancement Course - III	EIE	AEC	1	0	0	1	1
				Total	16	2	3	21	26
11	PE83/ YO83/ NS83	Physical Education Yoga NSS		NCMC				(Pass/ Fail)	
12	AM31	Additional Mathematics - I *	MAT	--	0	0	0	0	3

<p>NOTE: Branches: CSE, AI & ML, AI & DS, CSE(CS), CSE (AI & ML), ISE, ECE: Kannada (Kali / Manasu) in III Semester Constitution of India & Professional Ethics in IV Sem</p> <p>Branches: EEE, MLE, ETE, EIE, ME, CV, IEM, CH, BT: Constitution of India & Professional Ethics in III Semester Kannada (Kali / Manasu) in IV Semester</p>
<p>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</p>
<p>L –Lecture, T – Tutorial, P- Practical/ Drawing</p>

<p>Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with practical of the same course. Credit for IPCC is 03 and its Teaching–Learning hours (L : T : P) can be considered as (2 : 0 : 1). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated only by CIE (no SEE). However, questions from the practical part of IPCC can be included in the SEE question paper.</p>
<p>HS39/ HS49 Kannada Manasu is for students who speak, read and write Kannada and HS39/ HS49 Kannada Kali is for non-Kannada speaking, reading, and writing students.</p>
<p>The Non Credit Mandatory Course, Physical Education (Sport and Athletics)/Yoga/National Service Scheme (NSS):</p> <ol style="list-style-type: none"> 1. Student shall select any one of the NCMC’s namely, Physical Education (Sport and Athletics)/Yoga/ NSS prescribed for VIII semesters and shall attend the course from the III semesters and upto end of VIII semesters to complete all the formalities of the course and appear for the SEE. Marks scored in SEE shall be included in the VIII semester grade card. 2. The above mentioned NCMC’s shall not be considered for vertical progression as well as for the calculation of SGPA/CGPA but completion of the courses shall be mandatory for the award of degree. 3. SEE marks will be allotted by the concerned course teacher based on attendance and performance in the practice sessions/field in the ratio of 50:50. Maximum CIE marks are 50. SEE should be awarded by the course teacher every semester (III to VIII) for 50 marks and marks scored by the student are scaled down to 50 in the VIII semester. 4. The students who take a course on Physical Education and Yoga, he/she has to take up the semester end practical examination prescribed for 100 marks. The students who opt for NSS course have to submit report and attend viva-voce examination. The marks of the report shall be 50 marks and for the presentation/viva-voce 50 marks. SEE scale down to 50 marks. 5. In case, any student fails to secure the minimum 40% of the prescribed marks, he/she shall be deemed to have secured ‘F’ grade.

*** Lateral Entry Students:**

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

Inter/Intra Institutional Internship: All the students admitted under lateral entry category shall have to undergo a mandatory summer Internship-I of 03 weeks during the intervening vacation of III and IV semesters. Summer Internship shall include Inter / Intra Institutional activities. A Viva-voce examination shall be conducted during IV semester and the prescribed credit shall be included in IV semester after students clearing this head. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete during subsequent examination after satisfying the internship requirements during subsequent semesters.

Lateral Entry Students:

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

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

SCHEME OF TEACHING
IV SEMESTER

Sl. No.	Course Code	Course Name	Teaching Dept.	Category	Credits				Contact Hours
					L	T	P	Total	
1	EI41	Numerical Methods and Probability Models	MATH	BSC	2	1	0	3	4
2	EI42	Control Systems	EIE	IPCC	2	0	1	3	4
3	EI43	Embedded Controllers	EIE	PCC	3	0	0	3	3
4	EI44	Process Instrumentation	EIE	PCC	3	0	0	3	3
5	EI45	Digital Signal Processing	EIE	PCC	2	1	0	3	4
6	EIL46	Digital Signal Processing Lab	EIE	PCC	0	0	1	1	2
7	EIL47	Embedded Controllers Lab	EIE	PCC	0	0	1	1	2
8	EIL48	Process Instrumentation Lab	EIE	PCC	0	0	1	1	2
9	HS491	Kannada (Kali / Manasu)	Humanities	HSMC	1	0	0	1	1
10	xxAEC410	Ability Enhancement Course - IV	EIE	AEC	1	0	0	1	1
11	INT411	Inter/ Intra institutional internship	EIE	INT	0	0	2	2	-
				Total	14	2	6	22	26
12	AM41	Additional Mathematics II *	MATH	--	0	0	0	0	3

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

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

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

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

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with practical of the same course. Credit for IPCC is 03 and its Teaching–Learning hours (L : T : P) can be considered as (2 : 0 : 1). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated only by CIE (no SEE). However, questions from the practical part of IPCC can be included in the SEE question paper.

HS39/ HS49 Kannada Manasu is for students who speak, read and write Kannada and

HS39/ HS49 Kannada Kali is for non-Kannada speaking, reading, and writing students.

Innovation/ Societal/ Entrepreneurship based Internship: At the End of fourth Semester four - weeks summer internship shall be carried out at industry, State and Central Govt./NGO/MSME, Innovation centre’s or incubation centres. The internship can be Rural Internship. All the students shall have to undergo mandatory internship of 04 weeks during the intervening period of IV & V semesters. A Viva-Voce examination (CIE) shall be conducted during V semester and the prescribed credit shall be included in VI semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared fail and shall have to complete during subsequent examination after satisfying the internship requirements. The in-charge faculty has to monitor the student’s internship progress and interact to guide them for the successful completion of the internship. Innovation/ Societal/ Entrepreneurship based Internship shall have only CIE no SEE component.

* **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 fulfil the

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

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

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

III Semester

TRANSFORM TECHNIQUES AND LINEAR PROGRAMMING

Course Code: EI31	Credits: 2:1:0
Pre – requisites: Nil	Contact Hours: 28L+14T
Course Coordinator: Dr. Monica Anand & Dr. M. Girinath Reddy	

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/>
- Impartus recording: <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/>
- Impartus Recording: <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, Half range Fourier series, Practical harmonic analysis.

- 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

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/>
- Impartus Recording: <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 andBarlett Publishers Inc. – 3rd edition – 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) (Scaled to 50 marks)	100	CO1, CO2, CO3, CO4, CO5

ANALOG ELECTRONIC CIRCUITS

Course Code: EI32	Credits: 2:0:1
Pre – requisites: Basic Electronics (EC15)	Contact Hours: 28L+14P
Course Coordinator: Dr. Pushpa M K	

Course Content

Unit I

Introduction to analog electronics: Scope and applications of analog electronics, Construction and working principle, characteristics of JFET, Comparison of JFET and BJT, Biasing of JFET, JFET small signal model, Analysis of FET Common source amplifier with bypassed R_s and unbypassed R_s .

- Pedagogy/Course delivery tools: Chalk and Talk, PowerPoint presentation
- Impartus recording: <http://a.impartus.com/ilc/#!/course/81455/295>

Unit II

Parameters of OP-amps: Characteristics of OPAMP -I/P resistance, O/P resistance, CMRR, slew rate, open loop voltage gain, Bandwidth, input offset voltage, input offset current, Bias current.

Op-amp Applications: Basic circuits, Differential amplifier with one opamp, Instrumentation amplifiers, Comparators.

- Pedagogy/Course delivery tools: Chalk and Talk, PowerPoint presentation
- Impartus recording: <http://a.impartus.com/ilc/#!/course/81455/295>

Unit III

Active Filters using Op-amps: Comparison of Active & Passive filters, I order Butterworth Low Pass Filter, High Pass Filter, Band Pass Filter and Band Elimination Filter.

Oscillators using Op-amp: Principles of Oscillators, RC phase shift oscillator.

- Pedagogy/Course delivery tools: Chalk and Talk, PowerPoint presentation
- Impartus recording: <http://a.impartus.com/ilc/#!/course/81455/295>

Unit IV

555 Timer and Applications: Functional block diagram of 555 timer, Astable multivibrator and applications. Function generator block diagram.

PLL (565 PLL): Basic principle of PLL, Phase detectors, Applications of PLL as multiplier/divider, FSK generator and PLL as FSK demodulator.

- Pedagogy/Course delivery tools: Chalk and Talk, PowerPoint presentation
- Impartus recording: <http://a.impartus.com/ilc/#!/course/81455/295>

Unit V

Data Converters: Sample and Hold circuit and its specifications, **DAC:** Introduction, Classification, 4-bit Binary Weighted resistor DAC, **ADC:** Introduction, Classification of ADC, Ramp type ADC.

- Pedagogy/Course delivery tools: Chalk and Talk, PowerPoint presentation
- Links: <https://www.youtube.com/watch?v=zdMk2YpTmp0>
<https://www.multisim.com/content/3VKrbHxokt9DyqU4tyygDb/3-bit-flash-adc/>

Lab experiments:

1. Introduction to all measuring, source equipment's and Introduction to Software Simulator.
2. Integrator and Differentiator -simulation
3. V to I converters- Floating load and grounded load
4. Instrumentation amplifier- simulation
5. Schmitt triggers
6. Square wave generator using Schmitt trigger
7. II order Butterworth Low Pass Filter- simulation
8. II order Butterworth High Pass Filter -simulation
9. Wein bridge oscillator
10. Monostable multivibrator –simulation
11. 4 bit R-2R type DAC
12. 3 bit flash ADC - simulation

Text Books:

1. Ramakanth A Gayakwad, Opamps and Linear Integrated Circuits, 4th Edition, PHI.
2. Robert L Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, 9th Edition, PHI, 2006.

Reference Books:

1. MILLMAN - HALKIAS, Integrated Electronics, 33rd reprint TMH 1991.
2. Sergio Franco, Design with operational amplifiers and analog integrated circuits, 4th edition, Tata McGraw Hill.

Course Outcomes (COs):

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

1. Design amplifiers. (PO-1, PO-2, PO-3, PO-4, PSO-1)
2. Analyse various signal conditioning circuits. (PO-1, PO-2, PO-3, PO-4, PO-5, PSO-1)
3. Design filters and Oscillators. (PO-1, PO-2, PO-3, PO-4, PSO-1)

4. Explain the operation of 555 Timer and PLL (PO-1, PO-2, PO-3, PO-4, PSO-1)
5. Describe the operation and design Data converters. (PO-1, PO-2, PO-3, PO-4, PSO-1)

Course Assessment and Evaluation:

Continuous Internal Evaluation: 50 Marks		
Assessment tool	Marks	Course outcomes attained
Internal Test-I	30	CO2, CO3
Internal Test-II	30	CO1, CO4, CO5
Average of the two internal test shall be taken for 30 marks		
Other components		
Application on analog circuits - Lab Report	10	CO1 - CO5
Assignments	10	CO1 - CO5
Semester End Examination (SEE) (Scaled to 50 marks)	100	CO1 - CO5

NETWORK ANALYSIS

Course Code: EI33	Credits: 2:1:0
Pre – requisites: Basic Electrical Engineering (EE25)	Contact Hours: 28L+14T
Course Coordinator: Dr. K M Vanitha	

Course Content

Unit I

Passive Networks: V-I characteristics of idealized elements of networks, Sources: Independent (Ideal & practical), Dependent sources, Basic Laws (including Source transformation), Loop Analysis & Nodal Analysis with linearly dependent & independent sources for DC & AC networks (Concept of Super mesh & Super node), Star-Delta transformation, Duality in electrical networks.

- Pedagogy/Course delivery tools: Chalk and talk
- E Books: 1. Nptel.ac.in/courses/108105065- Networks signals and systems by Prof T.K. Basu, IIT Kharagpur. 2. Nptel.ac.in/courses/108102042- Circuit Theory by Prof Dutta Roy S.C, IIT Delhi 3. www.electrodiction.com/circuit-theory.
- MOOCs: 1. https://swayam.gov.in/nd1_noc19_ee36/preview
2. <http://elearning.vtu.ac.in/06ES34.html>
3. <https://www.coursera.org/course/circuits>

Unit II

Network Theorems: Superposition Theorem, Thevenin's & Norton's theorem, Maximum Power transfer theorem, Reciprocity & Millman's theorem.

- Pedagogy/Course delivery tools: Chalk and talk
- E Books: 1. Nptel.ac.in/courses/108105065- Networks signals and systems by Prof T.K. Basu, IIT Kharagpur. 2. Nptel.ac.in/courses/108102042- Circuit Theory by Prof Dutta Roy S.C, IIT Delhi 3. www.electrodiction.com/circuit-theory.
- MOOCs: 1. https://swayam.gov.in/nd1_noc19_ee36/preview
2. <http://elearning.vtu.ac.in/06ES34.html>
3. <https://www.coursera.org/course/circuits>

Unit III

Transient behavior and initial conditions: Behavior of circuit elements under switching condition & their representation, Evaluation of initial and final conditions in RL, RC and RLC circuits for DC & AC Excitation. **Resonant Circuits:** Series & Parallel resonance, Frequency response of Series & Parallel circuits.

- Pedagogy/Course delivery tools: Chalk and talk

- E Books: 1. Nptel.ac.in/courses/108105065- Networks signals and systems by Prof T.K. Basu, IIT Kharagpur. 2. Nptel.ac.in/courses/108102042- Circuit Theory by Prof Dutta Roy S.C, IIT Delhi 3. www.electrodiction.com/circuit-theory.
- MOOCs: 1. https://swayam.gov.in/nd1_noc19_ee36/preview
2. <http://elearning.vtu.ac.in/06ES34.html>
3. <https://www.coursera.org/course/circuits>

Unit IV

Laplace Transformation and its Applications: Review of Laplace transforms, Initial & final value theorem, convolution theorem, Periodic & A periodic waveforms, Time response of Single-Port passive networks.

- Pedagogy/Course delivery tools: Chalk and talk
- E Books: 1. Nptel.ac.in/courses/108105065- Networks signals and systems by Prof T.K. Basu, IIT Kharagpur. 2. Nptel.ac.in/courses/108102042- Circuit Theory by Prof Dutta Roy S.C, IIT Delhi 3. www.electrodiction.com/circuit-theory.
- MOOCs: 1. https://swayam.gov.in/nd1_noc19_ee36/preview
2. <http://elearning.vtu.ac.in/06ES34.html>
3. <https://www.coursera.org/course/circuits>

Unit V

Two Port Networks: Definition of Z, Y, h & T parameters, Modeling with these parameters, Relationships b/n 2 port n/w parameters, Interconnection of 2 port networks.

- Pedagogy/Course delivery tools: Chalk and talk
- E Books: 1. Nptel.ac.in/courses/108105065- Networks signals and systems by Prof T.K. Basu, IIT Kharagpur. 2. Nptel.ac.in/courses/108102042- Circuit Theory by Prof Dutta Roy S.C, IIT Delhi 3. www.electrodiction.com/circuit-theory.
- MOOCs: 1. https://swayam.gov.in/nd1_noc19_ee36/preview
2. <http://elearning.vtu.ac.in/06ES34.html>
3. <https://www.coursera.org/course/circuits>

Text Books:

1. N.O. Sadiku, Charles K. Alexander & Matthew, Fundamentals of Electric Circuits, 7th Edition, TMH publishers, 2022
2. Hayt, Kemmerley and Durbin, Engineering Circuit Analysis, TMH 8th Edition, 2015

References Books:

1. M.E. Van Valkenburg, Network analysis, PHI/Pearson Education, 3rd Edition, reprint 2002
2. David K. Cheng, Analysis of Linear Systems, Narosa Publishing House, 11th reprint, 2002
3. Bruce Carlson, Circuits, Thomson Learning, 2000. reprint 2002

Course Outcomes (COs):

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

1. Apply basic electrical laws and reduction techniques to linear circuits. (PO-1, PO-2, PSO-1)
2. Apply network theorems to simplify electric circuits. (PO-1, PO-2, PSO-1)
3. Analyze transient behavior of electric circuits and resonance conditions. (PO-1, PO-2, PSO-1)
4. Use Laplace transform to analyze electric circuits. (PO-1, PO-2, PSO-1)
5. Compute the two port network parameters. (PO-1, PO-2, PSO-1)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	Marks	Course outcomes attained
Internal Test-I	30	CO1, CO2
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal test shall be taken for 30 marks		
Other components		
Quiz/ Tutorial	10	CO1 - CO5
Assignment (using simulators)	10	CO1 - CO5
Semester End Examination (SEE) (Scaled to 50 marks)	100	CO1 - CO5

DIGITAL SYSTEM DESIGN

Course Code: EI34	Credits: 3:0:0
Pre – requisites: Basic Electronics (EC15)	Contact Hours: 42L
Course Coordinator: Dr. M. Jyothirmayi	

Course Content

Unit I

Introduction to Combination Logic: Review of Boolean algebra, SOP POS forms, K-maps (up to 4 variables), Map entered variables. **Introduction to Verilog:** Structure of Verilog module, Operators, data types, Styles of description- Data flow description, Behavioral description.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: <https://nptel.ac.in/courses/108106177> (week 2, 3)
- Online tool & Open source software: <https://circuitverse.org/simulator> (both hardware and verilog)
- Impartus recording: <http://a.impartus.com/ilc/#!/course/81456/295>

Unit II

Combinational Functions: Arithmetic Operations Adders: parallel adders, serial, Fast adders, and Subtractor: - using 1's and 2's compliment, Comparators – 2 bit and four bit, two bit Multiplier, Verilog Description for above circuits. **Multiplexers-** Realization of 2:1, 4:1 and 8:1 using gates & Applications. **Demultiplexers:** - Realization of 1:2, 1:4 and 1:8 using basic gates & Applications, Verilog description of Multiplexers and Demultiplexers.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: <https://nptel.ac.in/courses/108106177> (week 5,6)
- Online tool & Open source software: <https://circuitverse.org/simulator> (both hardware and verilog)
- Impartus recording: <http://a.impartus.com/ilc/#!/course/81456/295>

Unit III

Encoding and Decoding Codes: Binary coded decimal codes, Binary – Gray vice versa, Binary – Excess 3; Encoders and Priority Encoders, Decoders: BCD – Seven segment, Seven segment display. Programmable Logic Devices: PLA, PAL Verilog description for code converters and Encoders.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: <https://nptel.ac.in/courses/108106177>
- Online tool & Open source software: <https://circuitverse.org/simulator> (both hardware and verilog)

- Impartus recording: <http://a.impartus.com/ilc/#!/course/81456/295>

Unit IV

Sequential Logic Circuits: Review of Latches and Flip-Flops: SR-latch, D-latch, D flip-flop, JK flip-flop, T flip-flop Master slave FF, Registers and Shift Registers: PISO, PIPO, SISO, SIPO, Right shift and left shift, Universal Shift register Ring and Johnson counters. **Counters, design and their applications:** Modulo N counters – Synchronous and Asynchronous counters.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: <https://nptel.ac.in/courses/108106177> (week 7,8)
- Online tool & Open source software: <https://circuitverse.org/simulator> (both hardware and verilog)
- Impartus recording: <http://a.impartus.com/ilc/#!/course/81456/295>

Unit V

FSM: Structure of Moore model and Mealy Model, Definition of state machines, Analysis of Clocked Synchronous sequential networks-excitation and output expressions, transition equations, transition tables, excitation tables, state tables, state diagrams, network terminal behavior, Example of design of a simple FSM circuit.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: <https://nptel.ac.in/courses/108106177>
- Impartus recording: <http://a.impartus.com/ilc/#!/course/81456/295>

Text Books

1. Donald D Givone, Digital Principles and Design, 12th reprint, TMH, 2008
2. Morris Mano, Logic and Computer design fundamentals, 4th edition, PHI, 2006
3. Nazeih M. Botros, HDL Programming VHDL And Verilog 2009 reprint, Dreamtech press.

References

1. Tocci, Digital systems principle & applications, 8th Edition, PHI 2004
2. Donald P Leach, Albert Paul, Malvino, Goutam Saha, Digital Principles and Applications, 6th Edition TMH, 2006.

Course Outcomes (COs):

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

1. Acquire knowledge and perform reduction of logic functions using simplification techniques. (PO-1, PO-2, PO-9, PSO-1, PO-3)

2. Identify, analyze and design combinational circuits. (PO-1, PO-2, PO-3, PO-5, PO-9, PSO-1, PSO-3)
3. Write Verilog code using data flow and behavioral description. (PO-1, PO-2, PO-3, PO-5, PO-9, PO-12, PSO-1, PSO-3)
4. Analyze and design various Sequential circuits. (PO-1, PO-2, PO3, PS-9, PO-12, PSO-1, PSO-3)
5. Use the concepts of state transition for analysis and design of synchronous and asynchronous sequential circuits. (PO-1, PO-2, PO-3, PO-9, PO-12, PSO-1, PSO-3)

Course Assessment and Evaluation:

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

MEASUREMENT AND INSTRUMENTATION

Course Code: EI35	Credits: 3:0:0
Pre – requisites: Engineering Physics (PY12)	Contact Hours: 42L
Course Coordinator: Dr. Christina Grace and Dr. H. S. Niranjana Murthy	

Course Content

Unit I

Introduction, Classification & Calibration: Introduction; Elements of measurement system; Instrument classification, Static Instrument characteristics; Dynamic Instrument characteristics; Calibration: Need, Principles, Control of environment, Traceability, One, two, three-point calibration; Errors: Sources of systematic error; Reduction of system error; Quantification, Random error, Statistical analysis, 6-sigma process

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint presentation
- Links: <https://youtu.be/hI9osda1ro8>, <https://youtu.be/Oo0jm1PPRu0>

Unit II

Indicating, Recording and Display elements: Electronic multimeters, Digital Voltmeters, Cathode Ray Oscilloscopes (CRO), Digital Storage Oscilloscopes (DSO), Digital LCR meter

Data Acquisition Systems: Introduction to DAS, Analog Switches and Multiplexers, Sampling fundamentals, Sample and Hold circuit

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint presentation
- Links: <https://youtu.be/uxKyLTMv9js>

Unit III

Distance, level and force measurement: Sensor and signal conditioning - Capacitive, Resistive, Inductive, Radar methods, Ultrasonic sensor, Laser Doppler, LIDAR, Force measurement basics & Electronic load cell

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint presentation
- Virtual labs: <http://slcoep.vlabs.ac.in/Capacitance/capacitance.html>,
<http://slcoep.vlabs.ac.in/LinearVariableDifferentialTransformer/lvdt.html>

Unit IV

Pressure and Vibration measurement: Strain gauges – Introduction, Derivation, Types; Diaphragm and Strain gauges for pressure measurement; High pressure and

Vacuum pressure measurement; Differential pressure measurement; Vibration measurement: Introduction, Proximity sensor, Velocity pick up, Accelerometer

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint presentation
- Links: <https://youtu.be/zS77qnIEPg0>

Unit V

Temperature measurement: General principles of temperature measurement, Resistance temperature Detector, Thermocouple, Thermistor, Junction Semiconductor temperature sensors & signal conditioning, Optical pyrometer and bolometers – principles, types and working

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint presentation
- Links: <https://youtu.be/PccE4WcfnAw>

Text Books:

1. Measurement and Instrumentation: Theory and Application, Second edition, Alan S. Morris, Reza Langari, Elsevier publication, 2016
2. Instrumentation Measurement and Analysis: B C Nakra and KK Chaudhry, Tata McGraw Hill Education Private Limited, 4th Edition, 2016
3. “Modern Electronic Instrumentation and Measurement Techniques”, W.D. Cooper, PHI/Pearson, 2015

References:

1. John. P. Bentley, Principle of Measurement System, 3rd Edition, Pearson, 2007
2. N.E. Battikha, The condensed handbook of measurement and control, 4th Edition, ISA, 2018
3. D. Patranabis, Principles of Industrial Instrumentation, 2nd Edition, Tata McGraw Hill Education, 2008
4. Lessons In Industrial Instrumentation, by Tony R. Kuphaldt, Feb 2022, <https://control.com/textbook/>

Web links/ MOOC:

1. Selected topics in <https://nptel.ac.in/courses/108105153>
2. Selected topics in <https://nptel.ac.in/courses/112107242>
3. Selected topics in <https://nptel.ac.in/courses/112103261>

Course Outcomes (COs):

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

1. Explain the theory and principles behind various measurement techniques. (PO-1, PO-9, PO-10, PO-12, PSO-1, PSO-3)
2. Describe the working principle and construction of various measuring instruments. (PO-1, PO-2, PO-9, PO-10, PSO-1, PSO-3)
3. Illustrate the importance, characteristics and advantages of measuring instruments for a given application. (PO-1, PO-2, PO-3, PO-9, PO-10, PSO-1, PSO-3)
4. Estimate for output or input variables of measuring instruments for a given condition. (PO-1, PO-2, PO-3, PO-4, PSO-1, PSO-3)
5. Design signal conditioning circuits for measuring instruments. (PO-1, PO-2, PO-3, PSO-1, PSO-3)

Course Assessment and Evaluation:

Continuous Internal Evaluation CIE): 50 Marks		
Assessment tool	Marks	Course outcomes attained
Internal Test-I	30	CO2, CO4, CO5
Internal Test-II	30	CO1, CO3, CO4
Average of the two internal test shall be taken for 30 marks		
Other components		
Report on technical paper	10	CO1, CO2, CO3
Assignment	10	CO1 - CO5
Semester End Examination (SEE) (Scaled to 50 marks)	100	CO1-CO5

DIGITAL SYSTEM DESIGN LAB

Course Code: EIL36	Credits: 0:0:1
Pre – requisites: Basic Electronics (EC15)	Contact Hours: 14P
Course Coordinator: Dr. Jyothirmayi	

List of Experiments

Part-A: Hardware

1. Realization of Boolean expressions, half and full adder/full subtractor using NAND gates
2. Parallel Adder/ Subtractor using IC 7483
3. Multiplexer/ Demultiplexer: Use IC 74153, 74139 and solve Boolean expressions
4. Comparators using IC 7485, seven segment display
5. Flip flops, Shift registers, ring and Johnson counters
6. Counters using IC7493/ 74193
7. Asynchronous counters using Flipflops

Part-B: Software

Software Simulation, Implementation in Test bench and FPGA kit

1. Introduction to Xilinx ISE to create project, excute Verilog code, use test bench and down load to kit with Basic gates realization as an example.
2. Adders and Subtractors, Ripple carry adder using data flow description
3. Multiplexers using behavioral description (4:1, 8:1)
4. Encoders/ Decoders/ Priority encoders
5. Code converters and Comparators
6. Up and Down Counters; Shift Registers
7. Demo experiments on FSM machines
 - Students are required to perform 6 Hardware and 6 software prescribed experiments (from 2 to 7 in part A and B) in the above list.

Text Books:

1. Digital Design by Morris Mano
2. HDL with Digital Design VHDL & Verilog by N.Botros

Web links and Video Lectures (e-Resources):

1. <https://circuitverse.org/simulator>
2. <http://vlabs.iitkgp.ac.in/dec/>
3. <http://vlabs.iitb.ac.in/vlabs-dev/labs/digital-electronics/index.html>
4. <http://www.verilog.com/>
5. <https://www.veripool.org/verilator/>

Course Outcomes (COs):

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

1. Design and implement combinational circuits. (PO-1, PO-2, PO-3, PO-5, PO-9, PO-10, PSO-1, PSO-3)
2. Design and implement different sequential circuits. PO-1, PO-2, PO-3, PO-5, PO-9, PO-10, PSO-1, PSO-3)
3. Realize combinational circuits, shift registers and counters using Verilog in FPGA kits. PO-1, PO-2, PO-3, PO-5, PO-9, PO-10, PSO-1, PSO-3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	Marks	Course outcomes attained
Weekly evaluation of laboratory records/ reports after the conduction of every experiment. Follow up and Viva	15 15	CO1, CO2, CO3
Practical test	20	CO1, CO2, CO3
Semester End Examination (SEE)	50	CO1, CO2, CO3

MEASUREMENT AND INSTRUMENTATION LAB

Course Code: EIL37	Credits: 0:0:1
Pre – requisites: Engineering Physics (PY12)	Contact Hours: 14P
Course Coordinator: Dr. Christina Grace	

List of Experiments:

1. Linear and Angular displacement using capacitive transducer.
2. Displacement measurement using Potentiometer.
3. Displacement measurement using LVDT.
4. Strain gauge load cell.
5. Strain measurement using Cantilever beam.
6. Pressure transmitter/ transducer calibration.
7. Rough vacuum measurement using vacuum pressure transducer.
8. Displacement, Velocity and Acceleration measurement using Vibration sensor.
9. Temperature measurement with RTD.
10. Signal conditioning of Thermistor measurements.
11. Temperature measurement using AD595.
12. Current-type Temperature sensing using AD590.
13. Temperature and Distance measurement using IR sensor.
14. Absorbance measurement using optical sensors.

Text Book:

1. Measurement and Instrumentation: Theory and Application, Second edition, Alan S. Morris, Reza Langari, Elsevier publication, 2016
2. B.C.Nakra and N.K. Choudhary, Instrumentation Measurement and Analysis, Tata McGraw Hill Education, 4th Edition, 2016

Course Outcome (COs):

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

1. Measure temperature, displacement, strain and pressure. (PO-1, PO-2, PO-3, PO-9, PO-10, PSO-1, PSO-3)
2. Implement appropriate signal conditioning for various measuring instruments. (PO-1, PO-2, PO-3, PO-9, PO-10, PSO-1, PSO-3)
3. Analyze the performance characteristics of different measuring instruments. (PO-1, PO-2, PO-3, PO-9, PO-10, PSO-1, PSO-3)

Course Assessment and Evaluation:

Continuous Internal Evaluation CIE): 50 Marks		
Assessment tool	Marks	Course outcomes attained
Weekly evaluation of laboratory records/ reports after the conduction of every experiment. Follow up and Viva	20 10	CO1, CO2, CO3
Practical test	20	CO1, CO2, CO3
Semester End Examination (SEE)	50	CO1, CO2, CO3

UNIVERSAL HUMAN VALUES

Course Code: UHV38	Credits: 2:0:0
Pre – requisites: Nil	Contact Hours: 28L
Course Coordinator: Dr. H. S. Niranjana Murthy	

Course content

Unit I

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

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

Unit II

Understanding Harmony in the Human Being - Harmony in Myself!

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

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

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

Unit III

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

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

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

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

Unit IV

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

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

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

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

Unit V

Implications of the above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
4. 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.
5. Case studies of typical holistic technologies, management models and production systems
6. 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=PLWDeKF97v9SP7wSlapZcQRrT7OH0ZIGC4>
3. **Course handouts:**
https://drive.google.com/drive/folders/1zioX_4L2fCNX4Agw282PN86pcZZT3Osr?usp=sharing
4. **Presentation slides:**
https://drive.google.com/drive/folders/1rMUKh1s0HPRBlpp_b1mpS-duNRcwS6YH?usp=sharing

Course Outcomes (COs):

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

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

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE)		
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		
<ul style="list-style-type: none">• Assignment• Quiz• Presentation• Model / mini project• Any other	20 (10 + 10)	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE) Scaled to 50 Marks	100	CO1, CO2, CO3, CO4, CO5

CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS

Course Code: HS392	Credits: 1:0:0
Pre – requisites: Nil	Contact Hours: 14L
Course Coordinator: Mrs. Kanya Kumari S	

Course Content

Unit I

Introduction to the Constitution of India

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

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

Unit II

Relevance of Directive Principles of State Policy -part-IV

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

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

Unit III

Union executive and State executive

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

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

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

Unit IV

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

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

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

Unit V

Human Rights and Professional Ethics

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

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

Text Books:

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

Reference Books:

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

Course Outcomes (COs):

At the end of the course students will be able to

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

Course Assessment and Evaluation:

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

ABILITY ENHANCEMENT COURSE - III

Course Code: AEC310	Credits: 1:0:0
Pre – requisites: Nil	Contact Hours: 14L
Course Coordinator: Dr. Rama Shivakiran Reddy	

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

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

PHYSICAL EDUCATION

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

Course Learning Objectives:

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

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

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

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

Session 1

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

Session 2

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

Session 3

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

Course Outcomes (COs):

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

Course Assessment & Evaluation:

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

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

Course Learning Objectives:

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

Course Content

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

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

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

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

Course Outcomes (COs):

At the end of the course, a student will

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

Reference books:

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

Pedagogy:

Chalk and talk, demonstration, videos, ppt.

Contact Sessions:

There would be one introduction class, and five contact classes in each semester.

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

Online reference sources:

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

Course Assessment & Evaluation:

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

Scheme of SEE

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

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

Course Learning Objectives:

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

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

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

- Education towards pollution control and traffic management.
- Production of documentaries and short films/videos for motivating people on any of the above causes.

Course Outcomes (COs):

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

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

Contact Sessions:

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

Course Assessment & Evaluation:

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

ADDITIONAL MATHEMATICS – I

Course Code: AM31	Credits: 0:0:0
Pre – requisites: Nil	Contact Hours: 42L
Course Coordinator: Dr. Shashi Prabha Gogate S	

Course Content

Unit I

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

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

Unit II

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

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

Unit III

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

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

Unit IV

Vector Differentiation: Scalar and vector fields, gradient of a scalar field, directional derivative, divergence of a vector field, solenoidal vector, curl of a vector field,

irrotational vector. Laplace's operator. Vector identities connected with gradient, divergence and curl.

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

Unit V

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

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

Text Books:

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

Reference Books:

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

Course Outcomes (COs):

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

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

IV Semester

NUMERICAL METHODS AND PROBABILITY MODELS	
Course Code: EI41	Credits: 2:1:0
Pre – requisites: Nil	Contact Hours: 28L+14T
Course Coordinator: Dr. Monica Anand & Dr. M. Girinath Reddy	

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 $1/3^{\text{rd}}$ rule and Simpson's $3/8^{\text{th}}$ 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, 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 – 4th 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)
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)
3. Find parameters of continuous probability distributions and calculate the marginal and conditional distributions of bivariate random variables. (PO-1, PO-2, PSO-1)
4. Determine the parameters of stationary random processes and use Markov chain in prediction of future events. (PO-1, PO-2, PSO-1)
5. Choose an appropriate test of significance and make inference about the population from a sample. (PO-1, PO-2, PSO-1)

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) (Scaled to 50 marks)	100	CO1, CO2, CO3, CO4, CO5

CONTROL SYSTEMS	
Course Code: EI42	Credits: 2:0:1
Pre – requisites: Network Analysis (EI33)	Contact Hours: 28L+14T
Course Coordinator: Dr. K M Vanitha	

Course Content

Unit I

Modeling of Systems: Types of Control Systems, Mathematical models of physical systems – Introduction- Differential equations of physical systems (Mechanical systems, Friction, Translational systems) (Mechanical accelerometer, Levered systems excluded), Mathematical models of Rotational systems- Gear trains, Analogous systems. **Block Diagrams and signal flow graphs:** Transfer functions, Block diagram algebra, Signal flow graphs (State variable formulation excluded)

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://onlinecourses.nptel.ac.in/noc17_ee12/preview
- MIT Open Course in Systems and Control, <http://ocw.mit.edu/courses/mechanical-engineering/2-04a-systems-and-controls-spring-2013/>
- Impartus recording: <http://a.impartus.com/ilc/#/video/id/859549>

Unit II

Time Response of feedback control systems: Standard test signals, Steady state errors and error constants, Unit step response of first and second order systems, Time response specifications of second order systems. P, PI, PD and PID compensation.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://onlinecourses.nptel.ac.in/noc17_ee12/preview
- MIT Open Course in Systems and Control, <http://ocw.mit.edu/courses/mechanical-engineering/2-04a-systems-and-controls-spring-2013/>
- Impartus recording: <http://a.impartus.com/ilc/#/video/id/859549>

Unit III

Stability Analysis: Concept of Stability, Routh –Hurwitz Criterion, Root Locus Technique, Construction of root locus, stability, Dominant poles.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://onlinecourses.nptel.ac.in/noc17_ee12/preview
- MIT Open Course in Systems and Control, <http://ocw.mit.edu/courses/mechanical-engineering/2-04a-systems-and-controls-spring-2013/>
- Impartus recording: <http://a.impartus.com/ilc/#/video/id/859549>

Unit IV

Frequency domain analysis: Correlation between time and frequency response, Frequency response -Bode plot, Polar plot, Frequency domain specifications from the plots.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://onlinecourses.nptel.ac.in/noc17_ee12/preview
- MIT Open Course in Systems and Control, <http://ocw.mit.edu/courses/mechanical-engineering/2-04a-systems-and-controls-spring-2013/>
- Impartus recording: <http://a.impartus.com/ilc/#/video/id/859549>

Unit V

State Variable Analysis: Concept of state – State Variable and State Model – State space representation of systems described by scalar differential equations - State models for linear and continuous time systems – Examples from Mechanical systems and Electrical circuits- Solution of state and output equation – State transition matrix, controllability and observability

- Pedagogy/Course delivery tools: Chalk and talk
- https://www.youtube.com/watch?v=SbgsUt4O_us&list=PLLy_2iUCG87CVgIDEadTd_PRjA-g1KqVo&index=2

LIST OF EXPERIMENTS:

1. Introduction to MATLAB and using MATLAB for control systems.
2. Mathematical modeling of Physical systems.
3. Modeling of Physical systems using Simulink.
4. Block diagram Reduction.
5. Compute time response specifications for first and second order systems.
6. Introduction to PID controller.
7. Compute time response (through Root locus) and analyze system properties.
8. Compute frequency response (through Bode plots) and analyze system properties.
9. Transient response analysis in state space
10. State space model to transfer function conversion
11. Obtain a closed loop response for a given TF using state space
12. Observability and Controllability investigation

Text Books:

1. J. Nagrath and M.Gopal, “ Control Systems Engineering”, New age International (P) Limited, Publishers, Fourth edition – 2007

2. “Modern Control engineering”, K. OGATA, Pearson Education Asia/ PHI, 5th Edition
3. Ashish Tewari, Modern control Design with Matlab and Simulink, John Wiley, New Delhi, 2002.

Reference Books:

1. Richard C Dorf, Robert H Bishop, “Modern Control Systems”, Addison Wesley Publishing ISBN:0-201-32677-9, 2008
2. Farid and Kuo, Automatic control systems ,9th edition, John Wiley and sons.

Course Outcomes (COs):

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

1. Derive the transfer function and mathematical models of physical systems. (PO-1, PO-2, PO-5, PO-9, PSO-1, PSO-3)
2. Determine transient and steady state behavior of the system. (PO-1, PO-2, PO-5, PO-9, PSO-1, PSO-3)
3. Analyze the time domain stability of the system using RH criteria and root locus techniques. (PO-1, PO-2, PO-5, PO-9, PSO-1, PSO-3)
4. Find the frequency domain specifications. (PO-1, PO-2, PO-5, PO-9, PSO-1, PSO-3)
5. Model the physical process in state space form and solve state space equation. (PO-1, PO-2, PO-5, PO-9, PSO-1, PSO-3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	Marks	Course outcomes attained
Internal Test-I	30	CO1, CO2
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal test shall be taken for 30 marks		
Other components		
Quiz/ Assignment	10	CO1 - CO5
Lab experiments/ Assignments	10	CO1 - CO5
Semester End Examination (SEE) (Scaled to 50 marks)	100	CO1 - CO5

EMBEDDED CONTROLLERS

Course Code: EI43	Credits: 3:0:0
Pre – requisites: Fundamentals of Computing (CS26)	Contact Hours: 42L
Course Coordinator: Dr. Elavaar Kuzhali. S	

Course Content

Unit I

Introduction: Introduction to Microprocessors and Microcontrollers, RISC vs CISC, ARM embedded systems: The RISC design philosophy, The ARM design philosophy, embedded system hardware, embedded system software. ARM Architecture. ARM processor fundamentals: Registers, current program status register, pipeline.

- Pedagogy/Course delivery tools: Chalk and Talk, Power Point Presentation
- Link for Introduction to ARM embedded systems
<https://nptel.ac.in/courses/117106111>

Unit II

Introduction to ARM instruction set: Data Processing Instructions, Branch Instructions, Load Store Instructions, Software Interrupt Instruction, Program Status Register Instructions, Loading Constants, ARMv5E Extensions, and Conditional Execution.

- Pedagogy/Course delivery tools: Chalk and Talk, Power Point Presentation
- Link for ARM instruction set:
<http://103.170.244.45/~instrumentation/4th%20Semester/EI43>
<https://nptel.ac.in/courses/117106111>

Unit III

Introduction to the 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, Stack Instructions, and Software Interrupt Instruction.

- Pedagogy/Course delivery tools: Chalk and Talk, Power Point Presentation
- Link for THUMB instruction set:
<http://103.170.244.45/~instrumentation/4th%20Semester/EI43>
<https://nptel.ac.in/courses/117106111>

Unit IV

Interrupts & Exception Handling: Exceptions, Interrupts and vector table, Exception Handling Interrupts, Interrupt handling schemes- Non-Nested Interrupt Handler, Nested Interrupt Handler.

- Pedagogy/Course delivery tools: Chalk and Talk, Power Point Presentation
- Link for Interrupts & exception handling:
<http://103.170.244.45/~instrumentation/4th%20Semester/EI43>
<https://nptel.ac.in/courses/117106111>

Unit V

LPC 2148: Design of system using GPIO's (Interface to SWITCH, LED's, LCD interface, 4 x 4 Keypad), Timers, ADC, DAC, UART.

- Pedagogy/Course delivery tools: Chalk and Talk, Power Point Presentation
- Link for LPC2148 : <http://103.170.244.45/~instrumentation/4th%20Semester/EI43>
<https://www.nxp.com/docs/en/user-guide/UM10139.pdf>

Text Books:

1. “Andrew N.Sloss”, ARM system Developers Guide, Elsevier, 2008
2. “William Hohl”, ARM Assembly Language: Fundamentals and Techniques, Second Edition, CRC Press, 2014

Reference Books:

1. “J.R.Gibson”, ARM Assembly language An Introduction, Lulu.com, 2nd edition, 2011.
2. <https://www.nxp.com/docs/en/user-guide/UM10139.pdf>

Web links for video lectures (e-Resources):

1. <https://nptel.ac.in/courses/117106111>
2. <http://103.170.244.45/~instrumentation/4th%20Semester/EI43/>
3. [http://103.170.244.45/~instrumentation/6th%20Semester/EI61\(O\)](http://103.170.244.45/~instrumentation/6th%20Semester/EI61(O))
4. [Advanced%20Embedded%20Controllers/](#)

Course Outcomes (COs):

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

1. Understand the various aspects of ARM architecture (PO-1, PO-5, PSO-1)
2. Write programs using ARM instruction set. (PO-1, PO-3, PO-5, PO-9, PO-10, PSO-1, PSO-3)
3. Write programs using THUMB instruction set. (PO-1, PO-3, PO-5, PO-9, PO-10,

PSO-1, PSO-3)

4. Analyze the various ways of handling exceptions and interrupts in ARM processor. (PO- 1, PO-3, PO-5, PO-9, PO-10, PSO-1, PSO-3)
5. Write embedded C programs to interact with Built-in-Peripherals of ARM7-LPC2418. (PO- 1, PO-3, PO-5, PO-9, PO-10, PSO-1, PSO-3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	Marks	Course outcomes attained
Internal Test-I	30	CO1, CO2
Internal Test-II	30	CO3, CO4
Average of the two internal test shall be taken for 30 marks		
Other components		
Quiz	10	CO1, CO2
Assignment/ Project	10	CO3,CO5
Semester End Examination (SEE) (Scaled to 50 marks)	100	CO1 - CO5

PROCESS INSTRUMENTATION

Course Code: EI44	Credits: 3:0:0
Pre – requisites: Measurement and Instrumentation (EI35)	Contact Hours: 42L
Course Coordinator: Dr. J V Alamelu	

Course Content

Unit I

Basic Concept of Fluid Mechanics & Flow of Fluids: Introduction, properties of fluids, viscosity, fluids pressure at a point, properties, laws of pressure, types of fluids, types of fluid flow, rate of flow, equation of continuity, velocity and acceleration, types of motion, linear translation, deformation, angular deformation, rotation, vorticity, forced and free vortex flow.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: <https://www.youtube.com/watch?v=fa0zHI6nLUo> (NPTEL)
<https://nptel.ac.in/courses/112104118>
- Impartus recording: <https://a.impartus.com/ilc/#/course/2580504/1205>

Unit II

Flow of Fluids: Dynamics of flow, equations of motion, Euler’s equation, Bernoulli’s equation. **Head Type & Quantity Flow meters:** Orifice plate, Venturi tube, Flow nozzle, Pitot tube, Positive displacement flow meters – nutating disc and reciprocation piston.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: <https://www.youtube.com/watch?v=fa0zHI6nLUo> (NPTEL)
<https://nptel.ac.in/courses/112104118>
- Impartus recording: <https://a.impartus.com/ilc/#/course/2580504/1205>

Unit III

Area Flow meters & Mass Flow meters: Turbine flow meter, Rotameter, Coriolis mass flow meters, Thermal mass flow meter, Volume flow meter plus density measurement. **Electrical Type Flow Meter:** Electromagnetic flow meter – different types of excitation, schemes used, Ultrasonic flow meters, Vortex shedding flow meter, solid flow rate measurement, calibration of flow meters – dynamic weighing method.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: <https://archive.nptel.ac.in/courses/108/105/108105064/>
- Impartus recording: <https://a.impartus.com/ilc/#/course/2580504/1205>

Unit IV

pH and viscosity measurement: pH meters, conductivity measurements, Saybolt viscometer, Rotameter type viscometer, Suitable signal conditioners.

Humidity and Moisture: Definitions and basic theory, dry and wet bulb psychrometers, hot wire electrode type hygrometer, electrolysis type hygrometer, dew point meter, Different methods of moisture measurement.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: <https://archive.nptel.ac.in/courses/108/105/108105064/>
- Impartus recording: <https://a.impartus.com/ilc/#/course/2580504/1205>

Unit V

Micro sensors and Actuators: Introduction to MEMS, Bulk and surface micromachining, Cantilever beam type sensors, Comb type capacitive accelerometer, Micro actuator, Micro sensor integration and applications.

Instrument selection, Installation & Maintenance: Guidelines for selection of instruments, Data sheets handling, Ingression protection, Enclosures. Installation – P&ID diagram - checkout – lockout & tagout procedures. Maintenance – Implementation, Types, Records, Hazards, Electrical isolation.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: <https://nptel.ac.in/courses/108108147/>
- Impartus recording: <https://a.impartus.com/ilc/#/course/2580504/1205>

Text Books:

1. Bansal.R.K, Fluid Mechanics and Hydraulic Machines, Laxmi Publications, 2005.
2. E.O.Doeblin, Measurement systems application and design, 4th Edition TMH.
3. D.Patranabis, Principles of Industrial Instrumentation 2nd Tata McGraw Hill

Reference Books:

1. Radhakrishnan, E., Introduction to fluid Mechanics, Prentice Hall, India 2005.
2. Rajput R.K., Fluid Mechanics and Hydraulic Machines, S.Chand and Co., India.
3. John. P. Bentley, Principle of Measurement System, 3rd Edition, Pearson 2007. Bela .G. Liptak, Process Measurement.
4. N.E. Battikha, The condensed handbook of measurement and control, 4th Edition, ISA, 2018
5. Tai-Ran Hsu, MEMS And Microsystems: Design and Manufacture, 2017, Tata McGraw-Hill Education.

Course Outcomes (COs):

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

1. Describe the physical principles of fluid mechanics applied in process instrumentation. (PO-1, PO-2, PO-3, PSO- 1, PSO-2, PSO-3)
2. Explain the working principle of flow, pH, viscosity, Humidity and moisture and MEMS based measurements. (PO-1, PO-2, PO-3, PO-6, PO-7, PSO- 1, PSO-2, PSO-3)
3. Apply fluid mechanics and instrumentation concepts to solve numerical problems. (PO-1, PO-2, PO-3, PSO- 1, PSO-3)
4. Design suitable schematic for measurements, and signal conditioning circuits for sensors. (PO-1, PO-2, PO-3, PO-10, PO-12, PSO-1, PSO-3)
5. Elucidate important features and calibration, installation procedures for different types of instruments. (PO-3, PO-6, PO-7, PO-12, PSO-1, PSO-2, PSO-3)

Course Assessment and Evaluation:

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

DIGITAL SIGNAL PROCESSING	
Course Code: EI45	Credits: 2:1:0
Pre – requisites: Engg. Mathematics I & II (MA11 & MA21)	Contact Hours: 28L+14T
Course Coordinator: Dr. Shivaprakash G	

Course Content

Unit I

Introduction: Signals and Systems, Classification of Signals: Continuous & discrete, deterministic and random signals, Odd and even signals, Periodic & aperiodic signals, Causal & Non-causal, Power & Energy signal, Real and complex signals. Even and odd decomposition of signals.

Operation on signals: Operation on independent variables, Operations on dependent variable, precedence rule. Elementary CT signals: Unit step, ramp, impulse, exponential signal and sinusoidal signals. Elementary DT signals: Unit step, ramp, impulse, exponential signal and sinusoidal signals. Systems classification, Identification of system type using Impulse response of the system and its properties [1].

- Pedagogy/Course delivery tools: Chalk and talk
- Links: <https://nptel.ac.in/courses/108104100> (Signals and classifications, Prof. Aditya K. Jagannatham, IIT Kanpur). Lectures-1 to 9. Can download from the download tab.
<https://nptel.ac.in/courses/108106151> (DSP, C. S. Ramalingam, IIT Madras). First 14 videos under the download link.
- Impartus recording: <https://a.impartus.com/ilc/#/course/59757/295> (signals processing)

Unit II

DTFT representation of signals and properties of DTFT: Linearity, Time shift, Frequency shift, Time scaling, Differentiation in time, Differentiation in frequency, Summation in time, Convolution in time domain, Multiplication in time domain, Parseval's theorem [1].

DFT representation of signals and Properties of DFT: DFT representation of signals, twiddle factor and its properties, Computation of DFT by matrix method, analytical method, Relation between DTFT and DFT, Properties of DFT: Linearity, Time reversal, Circular time shift, Circular frequency shift, complex conjugation, Circular convolution, Circular correlation, Multiplication of two sequences, Parseval's theorem. IDFT. Numerical based on properties of DFT [2].

- Pedagogy/Course delivery tools: Chalk and talk
- Links: <https://nptel.ac.in/courses/117102060> (DSP, Prof. S.C. Dutta Roy, IIT Delhi). Lectures 8 to 11.
<https://nptel.ac.in/courses/108106151>(DSP, C. S. Ramalingam, IIT Madras). Under Download link, lectures with title DFT (Last nine videos).
<https://nptel.ac.in/courses/108101174> (DSP, Prof. V. M. Gadre, IIT Bombay). Week-4 for DTFT.

Unit III

Fast Fourier transforms: Definition of FFT (introduction to FFT), comparison of computation complexity of DFT computation by direct method and FFT method, Radix-2 decimation in time FFT for 4 & 8 points derivation and applications. Radix-2 decimation in time FFT for 4 & 8 points derivation and applications. Computation of IDFT using Flow-graphs, N composite FFT, Six-point DIT FFT, six-point DIF FFT [2][6].

- Pedagogy/Course delivery tools: Chalk and talk
- Links: <https://nptel.ac.in/courses/108104100> (Signals and classifications, Prof. Aditya K. Jagannatham, IIT Kanpur)
<https://nptel.ac.in/courses/117102060> (DSP, Prof. S.C. Dutta Roy, IIT Delhi)
<https://nptel.ac.in/courses/108106151>(DSP, C. S. Ramalingam, IIT Madras)
<https://nptel.ac.in/courses/108101174> (DSP, Prof. V. M. Gadre, IIT Bombay)

Unit IV

Digital filters: Introduction to digital filters, advantages of digital filters, Infinite Impulse response (IIR) Filters: types of IIR filters (Butterworth and Chebyshev), IIR filter design by approximation of derivatives, Derivation of Impulse invariant transformation, IIR Butterworth filter design by impulse invariant method, Derivation of Bilinear transformation and its properties, IIR Butterworth filter design using Bilinear transformation. Introduction to frequency transformations, basic filter transformation examples [3].

- Pedagogy/Course delivery tools: Chalk and talk
- Links: <https://nptel.ac.in/courses/117102060> (DSP, Prof. S.C. Dutta Roy, IIT Delhi). IIR filter design lecture 35.
<https://nptel.ac.in/courses/108101174> (DSP, Prof. V. M. Gadre, IIT Bombay). Week-7 for IIR filter design. Analog Frequency transformation in week-8, lecture 25A, Week-9 lecture 26A.

Unit V

FIR Filters: Introduction, advantages and disadvantages of FIR filters, Magnitude response and phase response of FIR digital filters, frequency response of linear phase FIR filters, Window functions for design of FIR filters, Design techniques for FIR filters- windowing method (only Hamming, Hanning, rectangular). [3]

Applications of DSP: DSP system, DTMF [5] standard, DTMF generation and detection, DSP based biotelemetry receiver, A speech processing system, an image processing system. DSP based power meter [4]

- Pedagogy/Course delivery tools: Chalk and talk
- Links: <https://nptel.ac.in/courses/117102060> (DSP, Prof. S.C. Dutta Roy, IIT Delhi). FIR filter design lecture 38 to 40.
<https://nptel.ac.in/courses/108101174> (DSP, Prof. V. M. Gadre, IIT Bombay). FIR filters week10 lecture 29A to 31B.

Text Books

1. Signals and Systems, Symon Haykin and Barry Van Veen, John Wiley and Sons.
2. Digital signal processing, Proakis and Manolakis, 3rdEdition Prentice Hall of India.
3. Introduction to Digital Signal Processing, Johny R johnson, PHI.
4. Digital signal processing, Avatar Singh and S. Srinivasan, Thomson.
5. Digital Signal Processing: A Computer Based Approach, Sanjit K. Mitra, McGraw-Hill.
6. Digital signal processing, S. Salivahanan, A. Vallavaraj, McGraw-Hill, 2009.

*Numbers mentioned in square brackets are the serial number of text books to be used.

References:

1. Signals and Systems: Alan V. Oppenheim, Alan S. Willsky, and with S. Hamid, PHI
2. Digital signal Processing-Alan V. Oppenheim, Ronald W. Schafer, Prentice Hall of India.

Course Outcomes (COs):

After completion of the course, the students will be able to-

1. Identify the type of the signal and apply basic operations to them. (PO-1, PO-2, PO-3, PO-9, PO-10, PSO-1, PSO-3)
2. Compute DTFT and DFT of the given signals using the properties of DFT and DTFT. (PO-1, PO-2, PO-3, PO-9, PO-10, PSO-1, PSO-3)
3. Compute DFT of a given signal using DIT-FFT and DIF-FFT algorithms. (PO-1, PO-2, PO-3, PO-9, PO-10, PSO-1, PSO-3)
4. Design a digital Butterworth filter using IIT and BLT to meet the given specifications. (PO-1, PO-2, PO-3, PO-9, PO-10, PSO-1, PSO-3)
5. Design an FIR linear phase filter using windowing method to meet the given specifications, students will have an understanding of basic applications of DSP. (PO-1, PO-2, PO-3, PO-9, PO-10, PSO-1, PSO-3)

Course Assessment and Evaluation:

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

DIGITAL SIGNAL PROCESSING LAB

Course Code: EIL46	Credits: 0:0:1
Pre – requisites: Nil	Contact Hours: 14P
Course Coordinator: Dr. G. Shivaprakash	

The lab course is designed to imparting skills required to develop a DSP system. Exposure to the DSK TMS3206713 and Scilab are the main features of the course.

List of experiments

1. Familiarization with SCILAB
2. Familiarization with code composer studio (CCS)
3. Experiment to compute the linear convolution (C program). Verify results using SCILAB.
4. Experiment to compute the circular convolution (C program). Verify results using SCILAB.
5. Experiment to compute the correlation (C program). Verify results using SCILAB.
6. Signal generation with given specification and basic operations on signals using SCILAB.
7. Experiment to determine the linear convolution using FFT (FFT library function call).
8. Experiment to determine the spectrum of given sequence using FFT (FFT library function call).
9. Experiment to design and test Butterworth I and II order low pass filter (C and Scilab programs).
10. Real-time Sine wave generation using look up table method.
11. Experiment to generate and detect DTMF signal using SCILAB software only.
12. Experiment to design and test FIR filter using hamming windowing techniques (C and Scilab programs).
13. Experiment to design and test FIR filter using hanning windowing techniques (C and Scilab programs).
14. FD Tool of MATLAB filter design.

Text Books

1. Signals and Systems, Symon Haykin and Barry Van Veen, John Wiley and Sons.
2. Digital signal processing, Proakis and Manolakis, 3rdEdition Prentice Hall of India.

3. Introduction to Digital Signal Processing, Johny R johnson, PHI.
4. Digital signal processing, Avatar Singh and S. Srinivasan, Thomson.
5. Digital Signal Processing: A Computer Based Approach, Sanjit K. Mitra, McGraw-Hill.
6. Digital signal processing, S. Salivahanan, A. Vallavaraj, McGraw-Hill, 2009.

Course Outcomes (COs):

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

1. Write programs (C/SCILAB) to compute convolution, correlation, FFT, and spectrum. (PO-1, PO-2, PO-5, PO-9, PO-10, PSO-1, PSO-3)
2. Design and implement IIR and FIR digital filters to meet given performance specifications. (PO-1, PO-2, PO-3, PO-5, PO-9, PO-10, PSO-1, PSO-3)
3. Write programs (SCILAB) for signal generation/manipulation and real-time DSP algorithms. (PO-1, PO-2, PO-5, PO-9, PO-10, PSO-1, PSO-3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	Marks	Course outcomes attained
Weekly evaluation of laboratory journals/ reports after the conduction of every experiment.	30	CO1, CO2, CO3
Practical test	20	CO1, CO2, CO3
Semester End Examination (SEE)	50	CO1, CO2, CO3

EMBEDDED CONTROLLERS LAB

Course Code: EIL47	Credits: 0:0:1
Pre – requisites: Fundamentals of Computing (CS26)	Contact Hours: 14P
Course Coordinator: Dr. Elavaar Kuzhali S	

List of experiments

Part A: Assembly language programs

1. (i) Swap two numbers without using an intermediate register
(ii) To find the factorial of a given number
(iii) Convert word of little endian format to big endian format.
2. Generate 12 bit Hamming code from a given 8 bit code
3. (i) Move a string from given memory location to another location
(ii) To Add N numbers of data stored consecutively in memory location
(iii) Translate the given C code to assembly, for $r(i=0; i<8; i++) \{a[i] = b[7 - i];\}$
4. (i) Move a block of data from memory location to another location using LOAD multiple and STORE multiple instructions
ii) Exchange a block of data between memory locations
5. i) Arrange a given set of data in ascending order
ii) Arrange a given set of data in descending order
6. i) Implement subroutine nesting using stack
ii) To implement ARM –THUMB interworking to find the smallest.
iii) To handle swi instruction in the program

Part B: C Programs

1. To familiarize I/O ports of LPC 2148 - on/off control of LEDs using switches
2. To display a given string using the LCD display interface
3. Interface key pad and to display the key pressed on LCD
4. Waveform generation using the internal DAC of LPC 2148.
5. To convert a given analog voltage to digital using ADC of LPC 2148.
6. Using timers to generate a specified delay
7. Using timer/counter/capture module of LPC 2148 to count the number of pulses and display on LCD.
8. Use of UART of LPC 2148 for transmitting and receiving data

Reference Books:

1. Laboratory manual prepared by the Electronics & Instrumentation Engineering department, RIT, Bangalore
2. <https://www.nxp.com/docs/en/user-guide/UM10139.pdf>

Web links for video lectures (e-Resources):

1. <http://103.170.244.45/~instrumentation/4th%20Semester/EI43/>
2. [http://103.170.244.45/~instrumentation/6th%20Semester/EI61\(O\)-Advanced%20Embedded%20Controllers/](http://103.170.244.45/~instrumentation/6th%20Semester/EI61(O)-Advanced%20Embedded%20Controllers/)

Course Outcomes (COs):

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

1. Write ARM/THUMB assembly level programs using Keil software. (PO-1, PO-3, PO-5, PO-9, PO-10, PSO-1, PSO-3)
2. Write embedded C programs to interact with Built-in-Peripherals (GPIO's, DAC, ADC, Timer/Counter, and UART) of ARM7 LPC 2418. (PO-1, PO-3, PO-5, PO-9, PO-10, PSO-1, PSO-3)
3. Write programs to handle exceptions and interrupts in ARM processor. (PO-1, PO-3, PO-5, PO-9, PO-10, PSO-1, PSO-3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	Marks	Course outcomes attained
Weekly evaluation of laboratory journals/ reports after the conduction of every experiment.	30	CO1, CO2, CO3
Practical test	20	CO1, CO2, CO3
Semester End Examination (SEE)	50	CO1, CO2, CO3

PROCESS INSTRUMENTATION LAB

Course Code: EIL48	Credits: 0:0:1
Pre – requisites: Measurement and Instrumentation (EI35)	Contact Hours: 14P
Course Coordinator: Dr. H S Niranjana Murthy and Dr. M D Nandeesh	

List of experiments

1. Flow measurement using Orifice flow meter.
2. Flow measurement using Venturi tube.
3. Flow measurement using rotameter.
4. Verification of Bernoulli's theorem.
5. Study of different types of flow and determination of Reynold's Number.
6. Viscosity measurement using Saybolt viscometer.
7. Relative Humidity measurement using capacitive sensor.
8. Relative humidity measurement using dry and wet bulb psychrometer.
9. Soil Moisture measurement.
10. pH measurement for various solutions.
11. Conductivity measurement.
12. Level measurement using differential pressure transmitter.
13. Study of various valve characteristics.
14. Study of electrical valve characteristics.

Text Book:

1. Bansal.R.K, Fluid Mechanics and Hydraulic Machines, Laxmi Publications, 2005.
2. E.O.Doeblin, Measurement systems application and design, 4th Edition TMH.
3. D.Patranabis, Principles of Industrial Instrumentation 2nd Tata McGraw Hill

Course Outcomes (COs):

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

1. Understand the measurement of flow, viscosity, humidity, moisture, PH, conductivity and level. (PO-1, PO- 2, PO-3, PO-9, PO-10, PSO-1, PSO-3)
2. Analyse the performance characteristics of various valves. (PO-1, PO- 2, PO-3, PO-9, PO-10, PSO-1, PSO-3)
3. Theoretically verify a few basic theorems. (PO-1, PO- 2, PO-3, PO-9, PO-10, PSO-1, PSO-3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	Marks	Course outcomes attained
Weekly evaluation of laboratory journals/ reports after the conduction of every experiment.	30	CO1, CO2, CO3
Practical test	20	CO1, CO2, CO3
Semester End Examination (SEE)	50	CO1, CO2, CO3

KANNADA KALI	
Course Code: HS491K	Credits: 1:0:0
Pre – requisites: Nil	Contact Hours: 14L
Course Coordinator: Mrs. Kanya Kumari S	

Unit I

(Parichaya) - Introduction

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

Introduction to Kannada Language, Karnataka State and Literature.

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

Unit II

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

Kannada namavisheshanagaLu - (Adjectives-Interrogatives)

kriyapadagaLu, kriya visheshaNagaLu- (verb-adverb)

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

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

Unit III

Samanya Sambhashaneyalli Kannadada Padagalu mattu Vaakyagalu

(Kannada Words and Sentences in General Conversation with activities)

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

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

Shabdakosha: Vocabulary – chaTuvaTike: Exercises

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

Sambhashane Conversation with House Owner and Room mate

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

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

Unit IV

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

Sambhashaneyalli Eakavachana mattu Bhahuvachana- (Singular and Plural nouns)

Conversation- Sambhashaneyalli Linga rupagaLu- Genders in Conversation

Viruddha padagalalu /Virodathaka padagalalu (Antonyms) Asamanjasa Uchcharane (Inappropriate Pronunciation)

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

Aaharakke sambandisida padagaLu(Names connected with food)

Manavana shareerada bhagalalu / Angagalalu (Parts of the Human body) Manava Sambhandhada da padhagalalu (Terms Relating to Human Relationship)

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

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

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

Unit V

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

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

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

Text Book:

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

Reference Book:

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

Course Outcomes (COs):

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

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

Course Assessment and Evaluation:

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

ಕನ್ನಡ ಮನಸು	
Course Code: HS491M	Credits: 1:0:0
Pre – requisites: Nil	Contact Hours: 14L
Program: B.E(Common to all the Branches)	Semester: IV
Course Coordinator: Mrs. Kanya Kumari S	

ಘಟಕ – 1 (Unit I)

ಲೇಖನಗಳು (Articles)– ಕಾವ್ಯಭಾಗ (poetry)

ಕನ್ನಡ ಭಾಷೆ ನಾಡು – ನುಡಿ

ಕರ್ನಾಟಕ ಸಂಸ್ಕೃತಿ

ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ

ವಚನಗಳು–ಅಕ್ಕಮಹಾದೇವಿ–ಬಸವಣ್ಣ–ಅಲ್ಲಮಪ್ರಭು

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

ಘಟಕ – 2 (Unit II)

ಕೀರ್ತನೆ ಮತ್ತು ತತ್ವ ಪದಗಳು

ಪುರಂದರ ದಾಸರು ಮತ್ತು ಕನಕದಾಸರ ಪದಗಳು

ಶಿಶುನಾಳ ಶರೀಫರು ಮಹಾಂತ ಶಿವಯೋಗಿಗಳ ಪದಗಳು

ಜನಪದ ಗೀತೆ

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

ಘಟಕ – 3 (Unit III)

ಆಧುನಿಕ ಕಾವ್ಯಗಳು

ಮಂಕುತಿಮ್ಮನ ಕಗ್ಗ

ಕುರುಡು ಕಾಂಚಾಣ

ಚೋಮನ ಮಕ್ಕಳ ಹಾಡು

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

ಘಟಕ –4 (Unit IV)

ತಾಂತ್ರಿಕ ಧುರೀಣರು(ವ್ಯಕ್ತಿ ಪರಿಚಯ) ಕಥೆ–ಪ್ರವಾಸ ಕಥನ

ಡಾ.ಸರ್.ಎಂ.ವಿಶ್ವೇಶ್ವರಯ್ಯ– ವ್ಯಕ್ತಿ ಮತ್ತು ಐತಿಹ್ಯ – ಎ,ಎನ್.ಮೂರ್ತಿರಾಯರು
ಯುಗಾದಿ –ವಸುಧೇಂದ್ರ

ಮೆಗಾನೆ ಎಂಬ ಗಿರಿಜನ ಪರ್ವತ -ಹಿ.ಚಿ.ಬೋರಲಿಂಗಯ್ಯ

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

ಘಟಕ- ೫ (Unit V)

ಕರಕುಶಲ ಕಲೆಗಳು -ತಾಂತ್ರಿಕ ವಿಜ್ಞಾನ (technical science)

ಕರಕುಶಲ ಕಲೆಗಳು -ಮತ್ತು ಪರಂಪರೆ ವಿಜ್ಞಾನ- ಕರಿಗೌಡ ಬೇಚನ ಹಳ್ಳಿ

ಕಂಫ್ಯೂಟರ್ ಹಾಗೂ ಮಾಹಿತಿ ತಂತ್ರಜ್ಞಾನ-

ಕೆ'ಮತ್ತು ಬ ಬರಹ ತಂತ್ರಾಂಶಗಳು ಮತ್ತು .ಕಂಫ್ಯೂಟರ್ ಮುಖಾಂತರ ಕನ್ನಡ ಟೈಪಿಂಗ್
ತಾಂತ್ರಿಕ ಪದಕೋಶ ತಾಂತ್ರಿಕ ಹಾಗೂ ಪಾರಿಭಾಷಿಕ ಕನ್ನಡ ಪದಗಳು

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

ಪಠ್ಯ ಪುಸ್ತಕ (text book):

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ'

ಸಂಪಾದಕರು : ಡಾ.ಹಿ.ಚಿ, ಬೋರಲಿಂಗಯ್ಯ -ವಿಶ್ರಾಂತ ಕುಲಪತಿಗಳು, ಕನ್ನಡ

ವಿಶ್ವವಿದ್ಯಾಲಯ ,ಹಂಪಿ,ಪ್ರಸಾರಂಗ ವಿಶ್ವೇಶ್ವರಯ್ಯತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ,ಬೆಳಗಾವಿ,ಪ್ರಥಮ
ಮುದ್ರಣ-2020

ಪೂರಕ ಪಠ್ಯ (reference book)

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

ಕನ್ನಡ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು:

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

Course Assessment and Evaluation:

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

ABILITY ENHANCEMENT COURSE - IV

Course Code: AEC410	Credits: 1:0:0
Pre – requisites: Nil	Contact Hours: 14L
Course Coordinator: Dr. Rama Shivakiran Reddy	

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

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

ADDITIONAL MATHEMATICS - II

Course Code: AM41	Credits: 0:0:0
Pre – requisites: Nil	Contact Hours: 42L
Course Coordinator: Dr. Veena B N	

Unit I

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

- Pedagogy/Course delivery tools: Chalk and talk
- Online tools: Use of open source software’s to demonstrate methods and solve problems on interpolation
- Links: <https://nptel.ac.in/courses/111/105/111105121/>
- Impartus recording: <https://a.impartus.com/ilc/#/course/107625/1030>

Unit II

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

- Pedagogy/Course delivery tools: Chalk and talk
- Online tools: Use of open source software’s to demonstrate methods and solve problems on numerical differentiation and integration.
- Links: <https://nptel.ac.in/courses/111/105/111105121/>
- Impartus recording: <https://a.impartus.com/ilc/#/course/107625/1030>
<https://a.impartus.com/ilc/#/course/59742/295>

Unit III

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

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

Unit IV

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

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

Unit V

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

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

Text Books:

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

Reference Books:

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

Course Outcomes (COs):

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

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