RAMAIAH
Institute of Technology

CURRICULUM

Outcome Based Education

Academic year 2023 – 2024

MEDICAL ELECTRONICS ENGINEERING

III & I V SEMESTER B.E.

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

About the Institute

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

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

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

About the Department

The Medical Electronics department at M S Ramaiah Institute of Technology (MSRIT), Bangalore was started in the year 1996 and renamed as Medical ElectronicsEngineering in the year 2020 by Visvesvaraya Technological University (VTU), Belagavi. The department has been accredited by NBA. In 2012, the Department was recognized as a Research Centre by VTU and offers Ph.D. and M.Sc. (Engg.) by research programs. The department is located at Lecture Hall Complex of RIT Campus and includes six established laboratories namely Diagnostic & Therapeutic Equipment Laboratory, Medical Electronics Laboratory, Medical Software Laboratory, Medical Instrumentation Laboratory, Texas Instruments Innovation Laboratory and Project Laboratory. The department consists of highly motivated & qualified faculty and dedicated supporting staff headedby Dr. Narayanappa C K having a teaching experience of more than twenty-five years with specialization in Control Systems and Image Processing. The current curriculum has been reviewed by experts from GE Healthcare, Philips Innovation Centre, Skanray Healthcare, Forus Healthcare, IIT Madras and MSR Medical College. The department conducts various training programs in addition to the syllabus for giving the students exposure to the latest developments in the industry.

VISION OF THE INSTITUTE

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

MISSION OF THE INSTITUTE

MSRIT shall meet the global socio-economic needs through

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

QUALITY POLICY

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

VISION OF THE DEPARTMENT

Provide quality education, motivational academic environment and foster a conducive Institute-industrial relationship to empower the students to face the real-time challenges in the field of engineering and medicine

MISSION OF THE DEPARTMENT

The department shall transform the entrant of the program into professionally competent engineers through innovative curricula, research, practical training and effective collaboration with industry, hospital and academia

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PEO 1: Solve the real-life engineering problems by employing the knowledgeand skills of Medical Electronics

PEO 2: Provide a multi-disciplinary environment to link engineering andmedical domains

PEO 3: Inculcate professional and ethical values in lifelong learning process

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: Acquire and comprehend the basic skill sets of mathematical approachesalong with analog and digital electronics essential in the development of biomedical systems

PSO2: Provide hardware and software oriented real-time solutions in healthcareusing the knowledge of Biomedical electronics and instrumentation

PSO3: Utilize the concepts of advanced clinical engineering to cater to the requirements of healthcare oriented applications

Semester wise Credit Breakdown for B.E Degree Curriculum

Batch 2022-26

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

BATCH 2022-2026

B.E. in Medical Electronics Engineering
Scheme of Teaching and Examination 2022-23
(Effective from the academic year 2022-23)

III SEMESTER

Sl. No.	Subject Code	Subject	Teaching Department	Category	Credits				Total contact hours /week
					L	T	P	Total	
1	MD31	Transform Techniques and Linear Programming	Maths	BSC	2	1	0	3	4
2	MD32	Signal Processing	MD	IPCC	3	0	1	4	5
3	MD33	Analog & Digital Electronic Circuits	MD	PCC	2	1	0	3	4
4	MD34	Human Anatomy	MD	PCC	1	0	0	1	1
5	MD35	Object Oriented Programming (OOP)	MD	PCC	3	0	0	3	3
6	MDL36	Analog & Digital Electronics Circuits Lab	MD	PCC	0	0	1	1	2
7	MDL37	Object Oriented Programming Lab	MD	PCC	0	0	1	1	2
8	UHV38	Universal Human Value Course	MD	UHV	2	0	0	2	2
9	MDAEC39	Ability Enhancement Course – III	MD	AEC	1	0	0	1	1
10	MD310	Human Physiology	MD	PCC	2	0	0	2	2
				Total	**16**	**2**	**3**	**21**	**26**
10	PE83	Physical Education		NCMC	All students have to register compulsorily for any one of the courses with the concerned coordinator (Yoga Teacher/ Physical Education Director/ NSS Coordinator) in the beginning of the III semester. Attending the registered course from III to VIII semesters. Qualifying is mandatory for the award of the degree.				
	YO83	Yoga							
	NS83	NSS							
12	AM31	Additional Mathematics - I *		NCMC	0	0	0	0	3

NOTE: Minimum of 1 subject should have a Tutorial component of 1 Credit.

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

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

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

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

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

***Lateral Entry Students:**

The Non-Credit Mandatory Course, Inter/Intra Institutional Internship: All the students admitted under the lateral entry category shall have to undergo a mandatory summer Internship of 02 weeks which is an NCMC course, during the intervening vacation of the III and IV semesters. Summer Internship shall include Inter / Intra Institutional activities. A Viva-voce examination shall be conducted during the IV semester. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of the degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete during subsequent examination after satisfying the internship requirements during subsequent semesters.

*** Lateral Entry Students:**

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

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

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

B.E. in Medical Electronics Engineering
Scheme of Teaching and Examination 2022-23
(Effective from the academic year 2022-23)

IV SEMESTER

Sl. No.	Subject Code	Subject	Teaching Department	Category	Credits				Total contact hours /week
					L	T	P	Total	
1	MD41	Numerical methods, Statistics and Probability	Mat	BSC	2	1	0	3	4
2	MD42	Control Systems	MD	IPCC	3	0	1	4	5
3	MD43	Linear Integrated Circuits and its Applications	MD	PCC	3	0	0	3	3
4	MD44	Real Time Embedded Systems	MD	PCC	3	0	0	3	3
5	MD45	Biomedical Signal Processing	MD	PCC	2	1	0	3	4
6	MDL46	Linear Integrated Circuits Lab	MD	PCC	0	0	1	1	2
7	MDL47	Real Time Embedded Systems Lab	MD	PCC	0	0	1	1	2
8	MDL48	Biomedical Signal Processing Lab	MD	PCC	0	0	1	1	2
9	MDAEC49	Ability Enhancement Course –IV	MD	AEC	1	0	0	1	1
10	INT410	Summer Internship- I	MD	NCMC	0	0	0	0	-
				Total	**14**	**2**	**4**	**20**	**26**
11	AM41	Additional Mathematics II *		NCMC	0	0	0	0	-

NOTE: Minimum of 1 subject should have a Tutorial component of 1 Credit.

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

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

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

*** Lateral Entry Students:**

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

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

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

III SEMESTER

TRANSFORM TECHNIQUES AND LINEAR PROGRAMMING	
Course Code: MD31	**Credits : 2:1:0**
Prerequisite: Nil	**Contact Hours: 28 L+14T**
Course Coordinator: Dr. Monica Anand and Dr. Shashi Prabha G. S.	

Course content

Unit I

Fourier Series: Review of orthogonal vectors and functions, Trigonometric Fourier series, orthonormal basis of Fourier series, Derivation of Fourier coefficients, Periodic functions, Dirichlet's conditions, Fourier series of periodic functions of period 2π and arbitrary period, Complex form of Fourier series, Half range Fourier series, Practical harmonic analysis, Solution of 1D- heat equation using Fourier series.

- 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 II

Fourier Transforms: Derivation of Fourier transforms from Fourier series, Infinite Fourier transform, Infinite Fourier sine and cosine transforms, Properties, Inverse transforms, Convolution theorem and its significance, Parseval's identity, Fourier transform of derivatives and integrals, Solution of PDE's using Fourier transforms.

- 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 III

Discrete Transforms: Z-transform of Standard functions, Linearity property, Damping rule, Shifting property, Initial and final value theorems, Convergence of Z-transforms, Inverse Z-transform, Convolution theorem, Application of Z-transforms to solve difference equations. Discrete Fourier transform (DFT), Inverse DFT, Fast Fourier transform (FFT), Limitations of Fourier transform.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111/107/111107119/
- Impartus Recording: https://a.impartus.com/ilc/#/course/119635/593

Unit IV

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

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111104027

Unit V

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

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111104027

Text Books:

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

References:

1. Fast Fourier Transform and Its Applications – Oran Brigham E. – Pearson – 1st edition -1988
2. Integral Transforms and Their Applications – Debnath, L., & Bhatta, D. – Chapman and Hall/CRC 2nd edition - 2015
3. Operations Research – Kalavathy S – Vikas Publishers- 4th edition-2013

Course Outcomes (COs):

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

1. Determine Laplace transform of standard functions. (PO-1, 2 & PSO-1)
2. Solve initial and boundary value problems using Laplace transforms. (PO-1, 2 & PSO-1)
3. Construct the Fourier series expansion of a function/tabulated data. (PO-1, 2 & PSO-1)
4. Evaluate Fourier transforms of functions and use it to solve ODE's. (PO-1, 2 & PSO-1)
5. Formulate and solve a simple linear programming problem. (PO-1, 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	**Marks**	**Course Outcomes Addressed**
Quiz	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

SIGNAL PROCESSING	
Course Code: MD32	**Credits : 3:0:1**
Prerequisite: Nil	**Contact Hours: 42L+14P**
Course Coordinator: Dr. C K Narayanappa and Dr. Sweeti	

Course Content

Unit I

Introduction to Signals &Systems: Standard Signals (Continuous and discrete), Classification of Signals (Continuous and discrete), basic operations on signals (Continuous and discrete), Classification of systems, Interconnections of systems.

- Pedagogy: Chalk and talk
- Impartus Recording: http://a.impartus.com/ilc/w/v/VQLR,VQLh,VQLA,VQLs,VQLE,VQLz,, VQLH,VQLu,VQLX, VQL4,VQL6

Unit II

Linear Time Invariant Systems: Convolution of continuous and discrete time Signals, Properties of convolution sum and integral, properties of systems step response of linear time invariant systems, sinusoidal steady state response, Solution of differential and difference equation.

- Pedagogy: Chalk and talk
- Impartus Recording: http://a.impartus.com/ilc/w/v/VQLy,VQLS,VQLL,VQLD,VQLN, VQLY, VQDx,VQDp, VQDb,VQDw,VQDV,VQDe

Unit III

Z transforms: Introduction to Z transform, ROC: properties (with proof) of finite and infinite duration sequences, ROC and stability, properties of ROC, Z transform of standard sequences, inverse Z transform (partial fraction method, long division method), unilateral z transform.

- Pedagogy / Course delivery tools: Chalk and talk
- Impartus Recording: http://a.impartus.com/ilc/w/v/VQDW,VQD8,VQDg,VQDc,VQD3

Unit IV

Fourier transform: Introduction to Fourier series, mathematical development of Fourier transform, magnitude and phase spectra of Fourier transform, properties of Fourier transform, inverse Fourier transform, applications. Introduction to DTFT, Sampling theorem, quantization.

- Pedagogy / Course delivery tools: Chalk and talk
- Impartus Recording: http://a.impartus.com/ilc/w/v/VQDl, VQDB, VQDa, VQDQ, VQDG, VQDv, VQDZ, VQDT

Unit V

DFT & FFT: Definition of DFT and inverse, Matrix relation to compute DFT and IDFT, Concept of circular shift and circular symmetry, properties of DFT, Fast Fourier transform (DIT and DIF approaches).

- Pedagogy Chalk and talk
- Impartus Recording: https://drive.google.com/file/d/1Ut0NUbdBCB6K8otyJRPKzCin6peOnBSE/ view?usp=sharing

Text Books:

1. Simon Haykin, "Signals and systems",5 Edition, Wiley India Publications, 2016
2. V Oppenheim & R W Schafer "Digital Signal Processing"–PearsonEducation / PHI, 5th Edition, 2015.
3. Ganesh Rao,Vineeth P Gejji" Digital Signal Processing"-Cengage publications 2017

Reference Books:

1. Sanjit K Mitra "Digital Signal Processing – A computer based approach"3rd-edition, McGraw Hill publications, 2017

Course Outcomes (COs):

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

1. Perform various operations on elementary signals used in systems and identify its properties. (PO-1; PSO-1)
2. Represent Linear Time Invariant (LTI) system through different techniques and analyze the relation between the input and output of an LTI system through its impulse response. (PO-1; PSO-1)
3. Represent different systems in the Frequency domain using Fourier Transforms and apply various properties of transform techniques in the analysis of signals and systems. (PO-1; PSO-1)
4. Represent different systems in the Frequency Domain Z transforms and highlight interrelationship between different transforms. (PO-1, 2,5; PSO-1,2)
5. To realize Discrete Fourier transforms and recognize the importance of techniques to solve discrete Fourier transforms faster using FFT (PO-1; 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	**Marks**	**Course Outcomes Addressed**
Quiz / Problem Solving	10	CO1, CO2, CO3
Lab Observation	10	CO1, CO2,CO3, CO4, CO5
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

ANALOG AND DIGITAL ELECTRONIC CIRCUITS	
Course Code: MD33	**Credits:2:1:0**
Prerequisite: Nil	**Contact Hours: 28L+14T**
Course Coordinator: Dr. Uma Arun and Dr. Mahendra S J	

Course Contents

Unit I

Transistors: Different transistor configuration (CB, CC), Transistor amplification action, Design of RC Coupled amplifier, Design of CC Amplifier (Emitter follower), Darlington emitter follower.

- Pedagogy/Course delivery tools: Chalk and Talk, Power point presentation
- Link: https://www.tutorialspoint.com/basic_electronics/basic_electronics_transistor_ configurations.htm

Unit II

Feedback amplifiers and Oscillators: Feedback concepts, Feedback connection Types, Oscillator operation ,RC phase shift ,Tuned oscillator circuit and crystal oscillator(Only BJT)

- Pedagogy/Course delivery tools: Chalk and Talk, Power point presentation
- Link: https://www.youtube.com/watch?v=SVQutMsLKfQ

Unit III

Introduction to digital logic families: Digital IC Terminology, The TTL Logic Family, TTL loading and Fan out, MOS Technology, Digital MOSFET circuits, Complementary MOS Logic, Tristate (Three-State) Logic outputs, ECL digital logic family

- Pedagogy/Course delivery tools: Chalk and Talk, Power point presentation
- Link: https://www.youtube.com/watch?v=nb11AipMJd4
  https://a.impartus.com/ilc/#/video/id/ 1185554 ,1183582

Unit IV

Combinational Logic circuits: Decoders, encoders, multiplexers, de-multiplexers, comparators, Applications of combinational logic circuits

- Pedagogy/Course delivery tools: Chalk and Talk, Power point presentation
- Link: https://www.tutorialspoint.com/computer_logical_organization/combinational_ circuits.htm
  https://a.impartus.com/ilc/#/video/id/1016440, 1038658

Unit V

Sequential Logic Circuits: Shift registers, Asynchronous and synchronous Counters, Up/Down Counters and Presentable Counters, Applications of counters.

- Pedagogy/Course delivery tools: Chalk and Talk, Power point presentation
- Link: https://www.allaboutcircuits.com/textbook/digital/chpt-11/asynchronous-counters/ https://a.impartus.com/ilc/#/video/id/1203640 , 1178675

Text Books:

1. Ronald J Tocci, Neal S Widmer Gregory L. Moss "Digital Systems Principles and Applications" Printice hall 12th Edition, 2018 .
2. Robert L. Boylested and Louis Nashelsky "Electronic Devices and Circuit Theory"- Pearson Education. 11th Edition, 2015.

Reference Books:

1. David A. Bell "Electronic Devices and Circuits" by - PHI, 5th Edition, 2010
2. John M Yarbrough "Digital Logic – Application and Design" - Thomson Brooks/Cole 7th Edition, 2012

Course Outcomes (COs):

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

1. Apply the basic knowledge of transistor to design various transistor configuration. (PO-1,2&PSO-1)
2. Understand the concept of feedback amplifiers and oscillators. (PO-1,2&PSO-1)
3. Interpret various characteristics of digital logic families (PO-1, 2&PSO-1)
4. Analysis the performance of decoders, encoders, multiplexers, demultiplexers and code converters. (PO-1,2& PSO-1)
5. Apply the knowledge in designing synchronous and asynchronous counters. (PO-1,2,3& PSO-1)

Web links and Video Lectures (e-Resources):

Impartus link-https://a.impartus.com/ilc/#/course/107724/533

Course Assessment and Evaluation:

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

HUMAN ANATOMY	
Course Code: MD34	**Credits : 1:0:0**
Prerequisite: Nil	**Contact Hours: 14**
Course Coordinator: Dr. Tejaswini. S	

Course Contents

Unit I

General Anatomy and Histology: Introduction to anatomy, cells and its components, Classification and functions of epithelial tissue, connective tissue, cartilage, bones, joints, muscles and skin.

- Pedagogy / Course delivery tools: Chalk and talk.
- Links: https://www.youtube.com/watch?v=ajRmcLOAoXc

Unit II

Cardiovascular system: Introduction, pericardium, sinuses, external features of heart, blood supply and interior of heart.

- Pedagogy / Course delivery tools: Chalk and talk.
- Links: https://www.youtube.com/watch?v=ajRmcLOAoXc

Unit III

Respiratory system: Introduction, nose, paranasal air sinuses, larynx, trachea, pleura, lung, bronchopulmonary segments.

- Pedagogy / Course delivery tools: Chalk and talk.
- Links: https://www.youtube.com/watch?v=ZkqJDsQR2kk

Unit IV

Nervous system; Classification of nervous system, Structure of neuron, neuroglial cells, meninges, CSF circulation, cerebrum, blood supply of brain, diencephalon, brainstem, cerebellum, spinal cord and cranial nerves

- Pedagogy / Course delivery tools: Chalk and talk.
- Links: https://www.youtube.com/watch?v=ZkqJDsQR2kk

Unit V

Alimentary system: oral cavity, salivary glands, tongue, pharynx, oespohagus, stomach, small and large intestine, liver, biliary system and pancreas

- Pedagogy / Course delivery tools: Chalk and talk.
- Links: https://www.youtube.com/watch?v=ZkqJDsQR2kk

Text Book:

1. Jayanthi V, “Text book of anatomy”, emmess publications

Reference Book:

1. Ross & Wilson's, "Anatomy and Physiology in Health and Illness", Anne Waugh and Allison Grant, 9th Edition, Churchill Livingstone Publications.2006

Course Outcomes (COs):

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

1. Explain the anatomical structure of human body. (PO-1, 6, 12; PSO-1)
2. Describe Cardio vascular system. (PO-1, 6, 12; PSO-1)
3. Explain the anatomical structure of respiratory system. (PO-1, 6, 12; PSO-1)
4. Relate the various anatomical parts of nervous system. (PO-1, 6, 12; PSO-1)
5. Explain the various parts of alimentary system (PO-1, 6,12; 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	**Marks**	**Course Outcomes Addressed**
Quiz	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

OBJECT ORIENTED PROGRAMMING (OOP)	
Course Code: MD35	**Credits : 3:0:0**
Prerequisite: Nil	**Contact Hours: 42**
Course Coordinator: Dr. Mahendra. S. J and Dr. Basavaraj V Hiremath	

Course Contents

Unit I

Introduction: Overview of C++, Sample C++ program, Different data types, operators, expressions, control and iterative statements, arrays and strings, pointers & function components, recursive functions, functions, call by value, call by reference, function overloading, inline functions, functions with default arguments, structure and enumerated data types.

- Pedagogy / Course delivery tools: Chalk and talk.
- Links: https://nptel.ac.in/courses/106101208
- Impartus Recording: https://a.impartus.com/ilc/#/course/2141067/1174

Unit II

Classes & Objects-I: classes, Scope resolution operator, passing objects as arguments, returning objects, and object assignment. Constructors, Destructors, friend functions, Parameterized constructors, Static data members, Arrays of objects, Pointers to objects, Operator overloading such as +, - ,*, pre-increment, post-increment.

- Pedagogy / Course delivery tools: Chalk and talk.
- Links: https://nptel.ac.in/courses/106101208
- Impartus Recording: https://a.impartus.com/ilc/#/course/2141067/1174

Unit III

Class and Objects - II and Inheritance: This pointer, and reference parameter, Dynamic allocation of objects, Copy constructors, Operator overloading using friend functions such as +, - ,++,--. Base Class, Inheritance and protected members, protected base class inheritance, inheriting multiple base classes, Constructors, Destructors and Inheritance, passing parameters to base class constructors, Granting access, Virtual base classes.

- Pedagogy / Course delivery tools: Chalk and talk.
- Links: https://nptel.ac.in/courses/106101208
- Impartus Recording: https://a.impartus.com/ilc/#/course/2141067/1174

Unit IV

Virtual functions, Polymorphism: Virtual function, calling a Virtual function through a base class reference, Virtual attribute is inherited, Virtual functions are hierarchical, pure virtual functions, Abstract classes, Using virtual functions, Early and late binding.

- Pedagogy / Course delivery tools: Chalk and talk.
- Links: https://nptel.ac.in/courses/106101208
- Impartus Recording: https://a.impartus.com/ilc/#/course/2141067/1174

Unit V

Data structures: Data representation, stacks, queues, Circular and priority queues, linked list, single linked list.

- Pedagogy / Course delivery tools: Chalk and talk.
- Links: https://nptel.ac.in/courses/111/105/111105134/
- Impartus Recording: https://a.impartus.com/ilc/#/course/2141067/1174

Text Book:

1. "Object Oriented programming with C++" RobertLafore, 4thedition, Galgotia Publications.2019.
2. "Data Structures, Algorithm and Applications in C++" SartajSahni, Tata McGrawHill Publications,2013.
3. Herbert Schildt, "The Complete Reference C++", 4th Edition, Tata McGraw Hill, 2011.

Reference Books:

1. Stanley B.Lippmann, JoseeLajoie: C++ Primer, 4th Edition, Addison Wesley, 2012.
2. "Object Oriented programming with C++" E Balaguruswamy, 4th Edition, TMH2011.
3. "Data Structures using C++" D.S. Malik, Thomson, 2010.

Course Outcomes (COs):

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

1. Identify classes, objects, members of a class and the relationships among them needed to solve a specific problem. (PO 1,2,3 & PSO 2)
2. Demonstrate the concept of constructors and destructors. And create new definitions for some of the operators.(PO 1,2,3 & PSO 2)
3. Create function templates, overload function templates, Understand and demonstrate the concept data encapsulation and inheritance.(PO 1,2,3 & PSO 2)
4. Demonstrate the concept of polymorphism with virtual functions. (PO 1,2,3 & PSO 2)
5. Demonstrate the concept of file operations, streams in C++ and various I/O manipulators. (PO 1,2,3 & PSO 2)

Course Assessment and Evaluation:

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

ANALOG AND DIGITAL ELECTRONICS CIRCUITS LABORATORY	
Course Code: MDL36	**Credits : 0:0:1**
Prerequisite: Nil	**Contact Hours: 14P**
Course Coordinator: Dr. Uma Arun and Dr. Mahendra S J	

Course Contents

1. Design and verification of frequency response of RC coupled amplifier.
2. Design and analysis of Emitter follower circuit
3. Design and analysis of Darlington & Bootstrapped Darlington circuit.
4. Design and verification of Hartely, Colpitts, oscillator
5. Design and verification of crystal oscillators.
6. Design and verification of RC phase shift oscillators.
7. Verification of encoder and decoder.
8. Verification of MUX 74153 and Implementation of half adder using MUX.
9. Verification of Parallel Adder and subtractor using the IC 7483
10. Verification of DEMUX- 74139 and Implementation of code converters using DEMUX
11. Implementation of 1bit comparator using logic gates and magnitude comparator using 7485
12. Verification of JK Master slave and implementation T and D flip-flop using IC 7446
13. Implementation of MOD N Counters using ICs 7476
14. Implementation of MOD N Counters using ICs, 7490

Text Books:

1. "Electronic Devices and Circuit Theory" by Robert L. Boylested and Louis Nashelsky- Pearson Education,11th Edition, 2015
2. "Digital Systems Principles and Applications" by Ronald J Tocci, Neal S Widmer Gregory L. Moss – Printice hall, 12th Edition, 2018

Course Outcomes (COs):

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

1. Design various linear and nonlinear circuits for required applications.(PO-1,2,3&PSO-1)
2. Demonstrate the practical skills of building circuits. (PO-1,2,3& PSO-1)
3. Analyze the Outputs both theoretically and practically. (PO-1,2,3&PSO-1)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course Outcomes Addressed**
Internal test-I	20	CO1, CO2, CO3
Other components	**Marks**	**Course Outcomes Addressed**
Viva	10	CO1, CO2, CO3
Record and Observation	20	CO1, CO2, CO3
Semester End Examination (SEE)	50	CO1, CO2, CO3

OBJECT ORIENTED PROGRAMMING LAB	
Course Code: MDL37	**Credits : 0:0:1**
Prerequisite: Nil	**Contact Hours: 14P**
Course Coordinator: Dr. Mahendra.S.J and Dr. Basavaraj V Hiremath	

Course Contents

1. Program using loops and control statements.
2. Program to illustrate pass by value and pass by reference.
3. Program to illustrate inline function and function with default arguments.
4. Program to illustrate structures and enumerated data type.
5. Program to illustrate class and objects and constructors.
6. Program to illustrate unary and binary operator overloading
7. Program to illustrate unary and binary operators using friend function.
8. Program to illustrate the concept of static data member, static data function and friend functions.
9. Program to illustrate virtual functions and pure virtual functions.
10. Program to implement stack using array.
11. Program to implement queue using array.
12. Program to implement circular queue using array.
13. Program to implement stack using single linked list.
14. Program to implement queue using single linked list.

- Impartus Recording: https://a.impartus.com/ilc/#/course/2141067/1174

Text Books:

1. Robert Lafore "Object Oriented programming with C++" , 4th edition,Galgotia Publications.2010.
2. E Balaguruswamy ,"Object Oriented programming with C++", 4th Edition, TMH2011.

References Books:

1. Herbert Schodit, "C++ The Complete Reference", 4th Edition, TMH, 2013.

Course Outcomes (COs):

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

1. Develop classes incorporating object-oriented techniques. (PO 1,2,3; PSO 2)
2. Design and implement object-oriented concepts of inheritance and polymorphism. (PO 1,2,3; PSO 2)
3. Illustrate and implement data structures using object oriented programs. (PO 1,2,3; PSO 2)

Course Assessment and Evaluation:

Continuous Internal Evaluation(CIE): 50 Marks		
Assessment Tool	**Marks**	**Course Outcomes Addressed**
Lab Test	20	CO1, CO2, CO3
Other components	**Marks**	**Course Outcomes Addressed**
Record and Observation	10	CO1, CO2, CO3
Continuous Evaluation	15	CO1, CO2, CO3
Viva	05	CO1, CO2, CO3
Semester End Examination (SEE)	50	CO1, CO2, CO3

UNIVERSAL HUMAN VALUE	
Course Code: UHV38	**Credits : 2:0:0**
Prerequisite: Nil	**Contact Hours: 28L**
Course Coordinator: Dr. Prabha Ravi and Dr. Sweeti	

Course Contents

Unit I

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

(6 Lectures)

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

Unit II

Understanding Harmony in the Human Being - Harmony in Myself! (6 Lectures)

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

Unit III

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

(6 Lectures)

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:
- Lab component / Practical Topics:
- Links: Harmony in Family- Trust
- Links: Harmony in family- Respect
- Links: Harmony in family- Other Feeling Justice
  Links: Harmony in the Society Chalk and talk, Power point presentation, Videos.
  Survey and polls for self-exploration
  https://youtu.be/F2KVW4WNnS8
  https://youtu.be/iLqNRPuv0_8
  https://youtu.be/TcYJB7reKnM
  https://youtu.be/BkWgFinrnPw

Unit IV

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

(4 Lectures)

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

Unit V

Implications of the above Holistic Understanding of Harmony on Professional Ethics

(6 Lectures)

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 system
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

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

Suggested Learning Resources:

Text Book:

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

Reference Books:

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

Web links and Video Lectures (e-Resources):

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

Course Outcomes (COs):

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

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

Course Assessment and Evaluation :

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course Outcomes Addressed**
Internal test-I	30	CO1, CO2, CO3
Internal test-II	30	CO3, CO4, CO5
Average of the two internal tests will be taken for 30 marks.		
Other components	**Marks**	**Course Outcomes Addressed**
• Assignment • Quiz • Presentation • Model / mini project • Any other	20 (10 + 10)	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)		
Course end examination (Answer any one question from each unit – Internal choice)	100	CO1, CO2, CO3, CO4, CO5

ABILITY ENHANCEMENT COURSE –III: SENSOR TECHNOLOGY	
Course Code: MDAEC39	**Credits : 1:0:0**
Prerequisite: Nil	**Contact Hours: 14L**
Course Coordinator: Dr. Uma Arun and Dr .N Sriraam	

Course Contents

Unit I

Data Acquisition and Sensor Characteristics: Sensors, Signals, and Systems, Sensor Classification, Units of Measurements, Span (Full-Scale Input), Accuracy, Calibration Error, Hysteresis, Nonlinearity, Saturation, Repeatability, Dead Band, Resolution, Dynamic Characteristics.

- **Pedagogy** Chalk and talk.
- **Video:** https://www.youtube.com/watch?v=AFamsIw3YnA
- **eBook Link:** https://rizkia.staff.telkomuniversity.ac.id/files/2017/11/Handbook-of-modern-sensors-physics-designs-and-applications-Fraden-Jacob-Springer-2016.pdf

Unit II

Physical Principles of Sensing: Electric Charges, Fields, and Potentials, Capacitance, Magnetism, Induction, Resistance, Piezoelectric Effect, Pyroelectric Effect, Hall Effect, Thermoelectric Effects, Temperature and Thermal Properties of Materials.

- **Pedagogy** Chalk and talk.
- **Video:** https://www.youtube.com/watch?v=O0RaetZIBuM
- **eBook Link:** https://rizkia.staff.telkomuniversity.ac.id/files/2017/11/Handbook-of-modern-sensors-physics-designs-and-applications-Fraden-Jacob-Springer-2016.pdf

Unit III

Interfacing of Electronic Circuits: Signal Conditioners, Sensor Connections, Excitation Circuits, Analog-to-Digital Converters, Integrated Interfaces, Noise in Sensors and Circuits.

- **Pedagogy** Chalk and talk.
- **Video:** https://www.youtube.com/watch?v=OFcrI9cRZug
- **eBook Link:** https://rizkia.staff.telkomuniversity.ac.id/files/2017/11/Handbook-of-modern-sensors-physics-designs-and-applications-Fraden-Jacob-Springer-2016.pdf

Unit IV

Displacement, Pressure, Force and Strain: Displacement -Potentiometric Sensors, Piezo resistive Sensors, Capacitive Sensors, Pressure -Concept of Pressure, Piezo resistive Sensors, Capacitive Sensors, Force -Strain Gauges, Pressure-Sensitive Films, Piezoelectric Force Sensors.

- **Pedagogy** Chalk and talk.
- **Video:** https://realpars.com/pressure-sensor/https://www.khanacademy.org/science/in-in-class11th-physics/in-in-mechanical-properties-of-solids/in-in-stress-strain-and-modulus-of-elasticity/v/stress-strain
- **eBook Link:** https://rizkia.staff.telkomuniversity.ac.id/files/2017/11/Handbook-of-modern-sensors-physics-designs-and-applications-Fraden-Jacob-Springer-2016.pdf

Unit V

Detector for Light, Ionizing Radiations and Temperature: Light- Introduction, Photodiode, Phototransistor, Photoresistor, Ionizing Radiations- Ionization Chambers, Proportional Chambers, Geiger–Mu¨ller (GM) Counters, Temperature- Resistance Temperature Detectors (RTD), Ceramic PTC Thermistors, Thermoelectric Sensors.

- **Pedagogy** Chalk and talk.
- **Links:** https://www.seeedstudio.com/blog/2020/01/08/what-is-a-light-sensor-types-uses-arduino-guide
  https://www.youtube.com/watch?v=HCvNMhskt5I
  https://www.youtube.com/watch?v=w3Hfj2kMrGo
- **eBook:** https://rizkia.staff.telkomuniversity.ac.id/files/2017/11/Handbook-of-modern-sensors-physics-designs-and-applications-Fraden-Jacob-Springer-2016.pdf

Text Books:

1. Handbook of modern sensors- physics, designs and applications by Jacob Freden, fifth edition, Springer.

Course Outcomes (COs):

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

1. Understand Data Acquisition and Sensor Characteristics (PO-1,2 & PSO-1).
2. Incorporate the knowledge of Physical Principles of Sensing. (PO-1,2 & PSO-1).
3. Understand Interfacing of Electronic Circuits. (PO-1,2 & PSO-1).
4. Inperpret importance of Displacement, Pressure, Force and Strain. (PO-1,2 & PSO-1.2).
5. Understand Detector for Light, Ionizing Radiations and Temperature. (PO-1,5 & PSO-2).

Course Assessment and Evaluation:

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

HUMAN PHYSIOLOGY	
Course Code: MD310	**Credits : 2:0:0**
Prerequisite: Nil	**Contact Hours: 28L**
Course Coordinator: Dr. Tejaswini. S	

Course Contents

Unit I

General Physiology: Homeostasis, Body fluids, resting membrane potential and action potential.

Hematology: Composition and functions of blood (RBC, hemoglobin, WBC), Blood Groups, Hemostasis.

Muscular system: Types and properties of muscles.

- Pedagogy / Course delivery tools: Chalk and talk.
- Links: https://www.youtube.com/watch?v=X3TAROotFfM

Unit II

Nervous System: Properties of nerve fibers**,** EEG, Autonomic nervous system and Autonomic function testing.

Special senses: Vision (refractive errors, colour vision), VEP, Hearing (functions of external, middle and inner ear), BAEP.

- Pedagogy / Course delivery tools: Chalk and talk.
- Links: https://www.youtube.com/watch?v=X3TAROotFfM

Unit III

Cardiovascular system: Conducting system of the heart, ECG, cardiac output and cardiac cycle, Heart sounds and Blood pressure.

- Pedagogy / Course delivery tools: Chalk and talk.
- Links: https://www.youtube.com/watch?v=-u1ngY5W14Y&list=PL4Wk_RxolZh-KOwLa6N9pdLjeKJVJbvRx
  https://www.youtube.com/watch?v=wmAsX_iG76g

Unit IV

Respiratory system: Functions of lungs, Lung volumes and capacities.

- Pedagogy / Course delivery tools: Chalk and talk.
- Links: https://www.youtube.com/watch?v=-u1ngY5W14Y&list=PL4Wk_RxolZh-KOwLa6N9pdLjeKJVJbvRx
  https://www.youtube.com/watch?v=wmAsX_iG76g

Unit V

Digestive and Excretory system: Stomach (HCl secretion, phases of gastric secretion), functions of liver and bile, movements of G.I.T., functions of Kidneys, GFR and factors affecting it, Micturition reflex, Cystometrogram.

Endocrine system: Functions of glands and applied Physiology**– (**Pituitary**,** Thyroid, Parathyroid, Adrenal, Pancreas).

- Pedagogy / Course delivery tools: Chalk and talk.
- Links: https://www.youtube.com/watch?v=48XO9iyZevs

Text Book:

1. Dr. Venkatesh & Dr. Sudhakar, "Basics of Medical Physiology", Wolters Kluwer Health Lippincott Williams and Wilkins, 3rd edition, 2010.

Reference Books:

1. Ross & Wilson's, "Anatomy and Physiology in Health and Illness", Anne Waugh and Allison Grant, 9th Edition, Churchill Livingstone Publications.2006
2. Sujit K. Chaudhuri," Concise Medical Physiology", 5th Edition, New Central Book Agency Pvt. Ltd.1996.

Course Outcomes (COs):

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

1. Explain the basic physiological functions of various types of organs within the human body. (PO-1, 6,12; PSO-1)
2. Analyze the basic physiological functions of nervous system (PO-1, 6, 12; PSO-1)
3. Explain the basic physiological functions of cardiovascular system (PO-1, 6, 12; PSO-1)
4. Analyze the basic physiological functions of respiratory system. (PO-1, 6, 12;PSO-1)
5. Analyze and interpret Digestive and Excretory system. (PO-1, 6, 12; 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	**Marks**	**Course Outcomes Addressed**
Quiz	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

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

Course Learning Objectives:

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

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

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

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

Session 1

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

Session 2

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

Session 3

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

Course Outcomes (COs):

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

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

Course Assessment & Evaluation:

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

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

Course Learning Objectives:

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

Course Content

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

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

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

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

Reference Books:

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

- **Pedagogy:** Chalk and talk, demonstration, videos, ppt.

Contact Sessions:

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

Online Reference Sources:

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

Course Outcomes (COs):

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

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

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 and 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**
Prerequisite: Nil	**Contact Hours: 42**
Course Coordinator: Dr. Shashi Prabha Gomati S	

Course Contents

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/
- **Impartus recording:** https://a.impartus.com/ilc/#/course/107625/1030

Unit III

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

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

Unit IV

Vector Differentiation: Scalar and vector fields, gradient of a scalar field, directional derivative, divergence of a vector field, solenoidal vector, curl of a vector field, irrational 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. (PO-1,2)
2. Apply the concept of reduction formula to determine the length, area, volume of revolution of an arc of the curve. (PO-1,2)
3. Solve the problems related to velocity and acceleration. (PO-1,2)
4. Apply vector differentiation to identify solenoidal and irrotational vectors. (PO-1,2)
5. Apply the concept of various methods to solve first order first degree differential equations. (PO-1,2)

Course Assessment and Evaluation:

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

IV SEMESTER

NUMERICAL METHODS, STATISTICS AND PROBABILITY	
Course Code: MD41	**Credits : 2:1:0**
Prerequisite: Nil	**Contact Hours: 28L+14T**
Course Coordinator: Dr. Monica Anand and Dr. Shashi Prabha G. S.	

Course Contents

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.

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

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

Unit II

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

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

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

Text Books:

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

Reference Books:

1. Probability and Statistics for Engineers and Scientists – R.E. Walpole, R. H. Myers, R. S. L. Myers and K. Ye –Pearson Education – Delhi – 9^{th} edition – 2012
2. Advanced Modern Engineering Mathematics – Glyn James –Pearson Education – 4^{th} 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, 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, 2 & PSO-1)
3. Find parameters of continuous probability distributions and calculate the marginal and conditional distributions of bivariate random variables. (PO-1, 2 & PSO-1)
4. Determine the parameters of stationary random processes and use Markov chain in prediction of future events. (PO-1, 2 & PSO-1)
5. Choose an appropriate test of significance and make inference about the population from a sample. (PO-1, 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	**Marks**	**Course Outcomes Addressed**
Quiz	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

CONTROL SYSTEMS	
Course Code: MD42	**Credits : 3:0:1**
Prerequisite: Nil	**Contact Hours: 42L+14P**
Course Coordinator: Dr C K Narayanappa and Dr. Uma Arun	

Course Contents

Unit I

Introduction to Control Systems: Introduction, Types of control systems, Design considerations, translational & rotational mechanical systems, Analogous systems.

Block Diagram & Signal flow graph: Introduction, transfer function, Elements of block diagram, closed loop transfer function, Block diagram algebra, Signal flow graphs, Introduction to MATLAB.

- Pedagogy / Course delivery tools: Chalk and talk.
- Impartus Recording: http://a.impartus.com/ilc/w/v/VQDC, VQDP, VQDM, VQDI, VQDn, VQD9, VQD2, VQDj, VQDf

Unit II

Time domain analysis of control systems: Introduction, standard test signals, Time response of First and second order systems, Design specifications of second order systems, Determination of undamped response, natural frequency & damping ratio, Step response of second order systems, Time domain specifications, System types, Different forms of representation, Steady state errors and error constants, Generalized error series, Approximation of higher order systems, Step response of second order systems with zeros.

- Pedagogy / Course delivery tools: Chalk and talk.
- Impartus Recording: http://a.impartus.com/ilc/w/v/VQDi, VQDK, VQDd, VQDF, VQDR, VQDh, VQDA

Unit III

Stability of Linear Control systems: Introduction, BIBO stability, Relationship between characteristic equation roots & BIBO stability, zero input stability, Stability criterion, RH criterion, RH analysis using Matlab

Root Locus: Introduction, The RL concept, steps for rapid plotting, RL analysis using Matlab.

- Pedagogy / Course delivery tools: Chalk and talk.
- Impartus Recording: http://a.impartus.com/ilc/w/v/VQDs, VQDE, VQDz, VQDH, VQDu, VQDX, VQD4, VQD6

Unit IV

Frequency Domain Analysis: Correlation between time and frequency response, Frequency domain specifications. **Bode Plot:** Introduction, Asymptotic approximations, Bode diagram for a practical system, Determination of transfer functions.

- Pedagogy / Course delivery tools: Chalk and talk.
- Impartus Recording: http://a.impartus.com/ilc/w/v/VQDS, VQDL ,VQDD , VQDN, VQDY

Unit V

Stability in the frequency domain: Introduction to polar plots (Inverse polar plots excluded).

State Space Theory: Introduction, concepts of state, State variable and state model, Selection of state variables, state model for linear continuous time systems, Solution to state equation, Non-homogenous solution, converting a transfer function to a state model.

Note: Matlab based problem solving topics are to be taught as demo sessions.

- Pedagogy / Course delivery tools: Chalk and talk.
- Impartus Recording: http://a.impartus.com/ilc/w/v/VQD0

Text Books:

1. Nagrath & Gopal, 'Control Systems Engineering', New Age International Publications, 5th Edition, 2009.
2. Katsuhiko Ogata, 'Modern Control Engineering', 6th edition, PHI, 2010
3. Michael C.K. Khoo," Physiological Control Systems -Analysis, Simulation and Estimation" Prentice Hall of India Pvt. Ltd., New Delhi, 2001.

Course Outcomes (COs):

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

1. Comprehend and interpret the basic concepts of control theory. (PO 1,2,3; PSO-1)
2. Compare the performances of a first and second order system in time domain. (PO-1,2,3; PSO-1)
3. Analyze the stability of a given system using different stability assessment techniques. (PO-1,2,6; PSO-1)
4. Assess the various factors involved with the time and frequency domain approaches and to use BODE plot based approach to conclude on the stability of a given system. (PO-1,2,6; PSO-1)
5. Apply polar plot technique for system stability analysis and to model a given system in state space thereby solving the state space equation. (PO-1,2,6; PSO-1).

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool:	**Marks**	**Course Outcome Addressed**
Internal test-1	30	CO1,CO2 & CO3
Internal test-1I	30	CO4 & CO5
Average of the two internal test two will be taken for 30 marks		
Other components	**Marks**	**Course Outcome Addressed**
Quiz / Problem solving	10	CO1,CO2,CO3
Lab Observation	10	CO1,CO2,CO3, CO4 & CO5
Semester End Examination (SEE)	100	CO1,CO2 , CO3, CO4 & CO5

LINEAR INTEGRATED CIRCUITS AND ITS APPLICATIONS	
Course Code: MD43	**Credits : 3:0:0**
Prerequisite: Nil	**Contact Hours: 42**
Course Coordinator: Dr. S J Mahendra and Dr. Uma Arun	

Course Contents

Unit I

Introduction to Operational Amplifiers and Characteristics: Power supply configurations for Op-Amp applications, inverting and non-inverting amplifier configurations, Summing amplifier, Integrators and differentiators.

The Practical op-amp: Introduction, input offset voltage, offset current, thermal drift, Effect of variation in power supply voltage, common-mode rejection ratio, slew rate and its Effect

- Pedagogy / Course delivery tools: Chalk and talk.
- Links: https://nptel.ac.in/courses/108108111
- Impartus Recording: https://a.impartus.com/ilc/#/course/1248149/1112

Unit II

Amplifiers and Oscillators: Instrumentation amplifier and its types, Voltage-series feedback amplifier, Voltage-shunt feedback amplifier, Log and Antilog amplifier, Triangular/rectangular wave generator, phase-shift oscillators, Wein bridge oscillator.

- Pedagogy / Course delivery tools: Chalk and talk.
- Links: https://nptel.ac.in/courses/108108111
- Impartus Recording: https://a.impartus.com/ilc/#/course/1248149/1112

Unit III

Active Filters: Characteristics of filters, Classification of filters, Magnitude and frequency response, Butter worth 1st and 2nd order Low pass, High pass and band pass filters, Band reject filters, Notch filter, All pass filters.

- Pedagogy / Course delivery tools: Chalk and talk.
- Links: https://nptel.ac.in/courses/108108111
- Impartus Recording: https://a.impartus.com/ilc/#/course/1248149/1112

Unit IV

Comparators and Converters: Comparator, Zero Crossing Detector, Voltage limiters, Clipper and clampers, Absolute value output circuit, Peak detector, Sample and hold Circuit, Precision rectifiers.

- Pedagogy / Course delivery tools: Chalk and talk.
- Links: https://nptel.ac.in/courses/108108111
- Impartus Recording: https://a.impartus.com/ilc/#/course/1248149/1112

Unit V

Multivibrator and Advanced Applications: Schmitt Trigger- inverting and non-Inverting type, Monostable and Astable Multivibrator using Opamp, Monostable and Astable Multivibrator using 555 timers, Linear and switching Voltage regulator using Opamp, Isolation Amplifier.

- Pedagogy / Course delivery tools: Chalk and talk.
- Links: https://nptel.ac.in/courses/108108111
- Impartus Recording: https://a.impartus.com/ilc/#/course/1248149/1112

Text Books:

1. Ramakant A. Gayakwad- "Op - Amps and Linear Integrated Circuits" PearsonIn, 4th Edition,2015
2. D. Roy Choudhury and Shail B. Jain "Linear Integrated Circuits" - New Age International, 5th Edition, 2018 Reprint.
3. B Somanath Nair "Linear Integrated Circuits- Analysis, Design & Applications" by, Wiely India Pvt. Ltd. 1st Edition, 2009.

Reference Books:

1. "Operational Amplifiers and Linear IC's" by David A. Bell, Oxford Higher Education, 3rd Edition 2011.
2. "Operational Amplifiers & Linear Integrated Circuits: Theory and Application / 3E: by James M. Fiore- Thomson Learning, 2019

Course Outcomes (COs):

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

1. Illustrate the working of operational amplifier and relate various characteristics of an operational amplifier (PO-1,9; PSO- 1)
2. Build various signal generation and signal enhancement circuits using op-amp (PO-1,3, 5, 9, 10,12; PSO- 1, 2)
3. Apply the knowledge of analog circuits and Op-Amp in the design of active filters. (PO-1,3, 5, 9, 10,12; PSO- 1, 2)
4. Analyze various signal processing circuits using Op-Amp. (PO-1,3, 5, 9, 10,12; PSO- 1, 2)
5. Make use of Op-Amps for advanced applications involving Multivibrator and, voltage regulation. (PO-1,3, 5, 9, 10,12; PSO- 1, 2)

Course Assessment and Evaluation:

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

REAL TIME EMBEDDED SYSTEMS	
Course Code: MD44	**Credits : 3:0:0**
Prerequisite: Nil	**Contact Hours: 42**
Course Coordinator: Dr. Basavaraj Hiremath and Dr. Uma Arun	

Course Contents

Unit I

Introduction to Microcontrollers based Embedded systems: Microcontrollers overview and applications, features and architecture considerations-ROM, RAM, Memory and I/O interfacing concepts, CISC Vs RISC design philosophy, Von-Neumann Vs Harvard architecture, instruction set, instruction formats, and various addressing modes of 32-bit. **Introduction ARM architecture and Cortex – M series**, Introduction to the Tiva family, Tiva block diagram, address space, on-chip peripherals (analog and digital) Register sets, Addressing modes and instruction set basics.

- Pedagogy / Course delivery tools: Chalk and talk, PPT.
- Impartus Recording: https://a.impartus.com/ilc/#/video/id/5191324
  https://a.impartus.com/ilc/#/video/id/5193993
- Link: https://a.impartus.com/ilc/#/video/id/5218610
  https://a.impartus.com/ilc/#/video/id/5220902

Unit II

Microcontroller Fundamentals for Basic Programming: I/O pin multiplexing, pull up/down registers, GPIO control, Memory Mapped Peripherals, programming System registers, Watchdog Timer. **System Clocks** and control, Hibernation Module on Tiva, Active vs Standby current consumption. Introduction to Interrupts, Interrupt vector table, interrupt programming. **Timer**, Basic Timer, Real Time Clock (RTC), Timing generation and measurements, Analog interfacing, and data acquisition: ADC.

- Pedagogy / Course delivery tools: Chalk and talk, PPT.
- Impartus Recording: https://www.slideshare.net/ZakriuaGomma/gpio-in-arm-cortexm4-tiva
  http://embedded-lab.com/blog/tiva-c-clock-system/
  http://shukra.cedt.iisc.ernet.in/edwiki/EmSys:TM4C123_Using_PLL

Unit III

Introduction to RTOS for Embedded Systems: RTOs Kernel: What is RTOs, RTOs necessity, bare-metal vs RTOS Real Time Scheduling, components of RTOs, RTOs start-up sequence. Overview of Threading modules: Hardware interrupts (Hwi), Software interrupts (Swi), Task, Background Thread (idle), comparison of thread characteristics, thread priorities & pre- emption, introduction to hook function.

- Pedagogy / Course delivery tools: Chalk and talk, PPT.
- Impartus Recording: https://a.impartus.com/ilc/#/video/id/5305230
  https://a.impartus.com/ilc/#/video/id/5315434

Unit IV

RTOs Synchronization modules: Semaphores: overview, where does semaphore fit? Create & delete, semaphore pend & semaphore post, semaphore modes, Context Switching, Deadlocks. RTOs Timing Services: overview of timing services, clock module, configuration of clock module, Timer module, Hardware Abstraction Layer (HAL) for Timer. **Mail Box**: data exchange between threads, creation and using a mailbox, mailbox post & pend Event Module: Semaphore Vs Event, Event Id, Event post & Event pend, pending on multiple semaphores, creation & usage of event, posting event using semaphores.

- Pedagogy / Course delivery tools: Chalk and talk, PPT.
- Impartus Recording: https://a.impartus.com/ilc/#/video/id/5345255
  https://a.impartus.com/ilc/#/video/id/5353740
  https://a.impartus.com/ilc/#/video/id/5355653
  https://a.impartus.com/ilc/#/video/id/5377618

Unit V

Communication Protocols: Communication protocols and Interfacing with external devices, Synchronous/Asynchronous interfaces (like UART, SPI, I2C), serial communication basics, baud rate concepts. **RTOs Debugging**: Introduction to RTOs instrumentation, RTOs analyzer and UIA, Execution Graph, Load Analysis, Log_info (), Benchmarking with Time Stamp.

- Pedagogy / Course delivery tools: Chalk and talk, PPT.
- Impartus Recording: https://www.slideshare.net/jph98/debugging-59431254
  https://slideplayer.com/slide/6061125/

Text Books:

1. TI-RTOS Kernel User's Guide by Texas Instruments
2. Real Time Operating System for ARM Cortex M Microcontrollers by Jonathan Valvano
3. Getting Started with Tiva ARM Cortex M4 Microcontrollers: Dhananjay V. Gadre, Sarthak Gupta
4. Embedded Systems: Real-Time Interfacing to Arm® Cortex™-M Microcontrollers, 2nd edition: Jonathan W. Valvano

Course Outcomes (COs):

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

1. Understand the basics of microcontroller and ARM Cortex M4F processor. (PO1,2,12 and PSO1)
2. Understand the peripherals and its working used with ARM cortex MF4 processor. (PO1,2,12 and PSO1,2)
3. Understand and design Real Time Operating System for Embedded Applications. (PO1,2,12, and PSO1,2)
4. Analyze the RTO's synchronization modules used for developing an algorithm. (PO1,2,12 and PSO1,2)
5. Understand the communication protocol and RTO's Debugger to analyze the user interface facility. (PO1,2,12 and PSO1,2)

Course Assessment and Evaluation:

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

BIOMEDICAL SIGNAL PROCESSING	
Course Code: MD45	**Credits : 2:1:0**
Prerequisite: Nil	**Contact Hours: 28L+14T**
Course Coordinator: Dr. Sweeti and Dr. Prabha Ravi	

Course Contents

Unit I

Introduction to Biomedical signal processing: Nature of biomedical signals, examples of biomedical signals (action potential of a cardiac myocyte, action potential of a neuron, Electroneurogram, electromyogram, electrocardiogram, electroencephalogram, Event related potentials, electrogastrogram, Phonocardiogram, carotid pulse, speech signals, vibromyogram, vibroarthrogram), objectives and difficulties encountered in biomedical signal analysis.

- **Pedagogy / Course delivery tools:** Chalk and talk.
- **Links:** https://onlinecourses.nptel.ac.in/noc20_ee41/preview
- **Impartus Recording:** https://a.impartus.com/ilc/#/course/2582486/1205

Unit II

IIR Filter Design and realizations: Introduction to IIR filters, Analog filter specification and classifications, Design of Butterworth and Chebyshev filters (both analog and digital versions – BLT and IIT for digitization), Realization of IIR filters (Direct forms, transposed structures, cascade and parallel forms).

- **Pedagogy / Course delivery tools:** Chalk and talk.
- **Links:** https://onlinecourses.nptel.ac.in/noc20_ee41/preview
- **Impartus Recording:** https://a.impartus.com/ilc/#/course/2582486/1205

Unit III

FIR filters: Introduction, paley wiener theorm, symmetric and asymmetric filters, locations of zeros in linear phase FIR filters, design of linear phase FIR filters using windows and design procedures, advantages and disadvantages of windowing, Design of FIR differentiators, frequency sampling design of FIR filters, Realization of FIR filters.

- **Pedagogy / Course delivery tools:** Chalk and talk.
- **Links:** https://onlinecourses.nptel.ac.in/noc20_ee41/preview
- **Impartus Recording:** https://a.impartus.com/ilc/#/course/2582486/1205

Unit IV

Filtering applications for artifacts removal: Random structured and physiological noise, time domain filters, frequency domain filters- Notch and Comb filters, optimal filters: Wiener filter, adaptive filters for the removal of interference: Adaptive Noise canceller, LMS adaptive filter, selecting the appropriate filter, applications.

- **Pedagogy / Course delivery tools:** Chalk and talk.
- **Links:** https://onlinecourses.nptel.ac.in/noc20_ee41/preview
- **Impartus Recording:** https://a.impartus.com/ilc/#/course/2582486/1205

Unit V

Detection of events: Event and wave detection: Derivative based methods, PAN TOMPKINS method, and Dichroitic notch detection. Correlation analysis of EEG rhythms, cross spectral techniques.

Data Reduction Technique: Turning Point, Huffman Coding, Run length Coding.

- **Pedagogy / Course delivery tools:** Chalk and talk.
- **Links:** https://onlinecourses.nptel.ac.in/noc20_ee41/preview
- **Impartus Recording:** https://a.impartus.com/ilc/#/course/2582486/1205

Text Books:

1. Rangaraj M Rangayyan, "Biomedical Signal Analysis", Wily Publications, 2nd Edition, 2016.
2. Proakis & Manolakis, PHI "Digital Signal Processing" 4th edition 2003, Pearson international edition
3. Ganesh Rao, Vineeth P Gejji "Digital Signal Processing"-Cengage publications 2017

Reference Books:

1. John L Semlow, "Bio-signal & and Biomedical Image Processing" –CRC Press, 3rd Edition, 2014.
2. Willis J Tompkins, "Biomedical Digital Signal Processing", PHI, Eastern economy edition.

Course Outcomes (COs):

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

1. Demonstrate an understanding of biomedical signals and identify the need for biomedical signal analysis. (PO-1,2,3,12; PSO-1,3)
2. Comprehend and interpret the various techniques involved in the design and implementation of IIR filters (PO-1,3; PSO-1)
3. Comprehend and interpret the various techniques involved in the design and implementation of FIR filters (PO-1,3; PSO-1)
4. Identify physiological interferences and artifacts affecting the biomedical signals and apply various filtering mechanisms for the enhancement of signals. (PO-2,4; PSO-1)
5. Detect various events involved in Biomedical signals and apply appropriate data reduction techniques. (PO-1,3; PSO-1)

Course Assessment and Evaluation:

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

LINEAR INTEGRATED CIRCUITS LAB	
Course Code: MDL46	**Credits : 0:0:1**
Prerequisite: Nil	**Contact Hours: 14P**
Course Coordinator: Dr. S J Mahendra and Dr. Uma Arun	

List of Experiments:

1. General Linear Applications of Op-Amp:
   a. Summing Amplifier
   b. Difference Amplifier
2. General Linear Applications of Op-Amp:
   a. Integrator
   b. Differentiator
3. Design and Implementation of Instrumentation Amplifier.
4. Design, Implementation and Analysis of 1st order Butterworth Active Low Pass Filter.
5. Design, Implementation and Analysis of 1st order Butterworth Active High Pass Filter.
6. Design, Implementation and Analysis of 1st order Butterworth Active Band Pass Filter.
7. Design, and Implementation of Notch Filter.
8. Design and Implementation of Schmitt Trigger.
9. Design and Implementation of Astable Multivibrator using Op-Amp.
10. Design and Implementation of Monostable Multivibrator using Op-Amp.
11. Design and Implementation of Astable Multivibrator using555 Timer.
12. Design and Implementation of Half wave precision rectifier
13. Design and Implementation of Full wave precision rectifier
14. Design and Implementation of 4- bit, R-2R ladder type DAC using Op-Amp

Text Books:

1. "Linear Integrated Circuits" by D. Roy Choudhury and Shail B. Jain- New Age International,2nd Edition, 2006 Reprint
2. "Op - Amps and Linear Integrated Circuits" by Ramakant A. Gayakwad- PHI, 4thEdition

Course Outcomes (COs):

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

1. Design OP-Amp circuits for various applications.(PO: 1,3,9,10; PSO:1,2)
2. Demonstrate the practical skills of building circuits. (PO: 1,3, 5, 9,10; PSO:1,2)
3. Analyze the Outcomes both theoretically and practically. (PO: 1,3,; PSO:2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course Outcomes Addressed**
Internal test-I	20	CO1, CO2, CO3
Other components	**Marks**	**Course Outcomes Addressed**
Viva	10	CO1, CO2, CO3
Record and Observation	20	CO1, CO2, CO3
Semester End Examination (SEE)	50	CO1, CO2, CO3

REAL TIME EMBEDDED SYSTEMS LAB	
Course Code: MDL47	**Credits : 0:0:1**
Prerequisite: Nil	**Contact Hours: 14P**
Course Coordinator: Dr.Basavaraj Hiremath and Dr. Uma Arun	

List of Experiments:

1. Introduction to Hardware & Software Platform:
   a. Overview of Code Composer Studiov9
   b. Installing TI-RTOs & TivaWare
   c. Configuration of GPIO module to blink an LED and read an input pin
2. Basic C-Programming Lab:
   a. A simple program to add & multiply 2 numbers
   b. Implementation of Convolution: Linear & Circular
3. Using IQmath Library for implementing Low pass FIR filter
4. Interrupt programming examples through GPIOs
5. Configuration of Timer module with interrupt to generate a 1 s delay
6. Using RTOs thread: configuring and using Hwi thread
7. Using RTOs thread: configuring and using Swi thread
8. Using RTOs thread: configuring and using Idle thread
9. Using RTOs thread: configuring and using Task thread
10. Semaphores: Creation of semaphore to synchronize between multiple Tasks
11. Clock Function: Use of clock module APIs to determine the sleeptime of tasks
12. MailBox: Passing data between threads by creating and using a mailbox
13. Events: Write a program to create event to handle three Interrupt Service Routines (ISRs)
14. RTOs Debugging: using UIA and RTOs Analyzer to debug RTOS application

- **Links:** http://shukra.cedt.iisc.ernet.in/edwiki/EmSys:TM4C123_Timer_Programming
  https://microcontrollerslab.com/gpio-interrupts-tm4c123-tiva-launchpad-edge-level-triggered/
  https://a.impartus.com/ilc/#/video/id/5327709
  https://a.impartus.com/ilc/#/video/id/5329871

Course Outcomes (COs):

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

1. Use the CCS software and use it to operate the GPIO using basic I/O operation. (PO-1,3,4 & PSO-1,2)
2. Implement effectively use concepts of C programming for development of optimized embedded software. (PO-1,3,4,5&PSO-1,2)
3. Obtain a conceptual and practical foundation for advanced embedded applications. (PO-1,3, 4,5&PSO-1,2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course Outcomes Addressed**
Internal test-I	20	CO1, CO2, CO3
Other components	**Marks**	**Course Outcomes Addressed**
Viva	10	CO1, CO2, CO3
Record and Observation	20	CO1, CO2, CO3
Semester End Examination (SEE)	50	CO1, CO2, CO3

BIOMEDICAL SIGNAL PROCESSINGLAB	
Course Code: MDL48	**Credits : 0:0:1**
Prerequisite: Nil	**Contact Hours: 14P**
Course Coordinator: Dr. Sweeti and Dr. Prabha Ravi	

Course Contents

1. Operations on Signals: Time Scaling, Amplitude Scaling, Linear Time Shift,
2. Operations on Signals: Circular Shifting, Linear Convolution, Circular Convolution.
3. To verify linearity and Circular convolution property of DFT.
4. To verify Multiplication in time domain property and Parseval's theorem for DFT.
5. To verify Sampling Theorem for a given signal.
6. Design of digital IIR Butterworth filters using Bilinear transformation and impulse invariant methods.
7. To design FIR filters using windowing Technique
8. Design and Implementation of Moving Average filters
9. Design and Implementation of Derivative Based Filters
10. Design and Implementation of Notch Filters and Comb Filters
11. To perform QRS detection using PAN-TOMPKINS algorithm
12. To perform derivative based QRS detection
13. Detection of EEG rhythms
14. To perform Spectral Analysis of Biomedical Signals

Text Books:

1. Rangaraj M Rangayyan, "Biomedical Signal Analysis", Wiley India Publications, 2015

Reference Books:

1. Robert J. Schilling, Sandra L Harris, "Fundamentals of Digital Signal Processing using MATLAB, 2011
2. Bio-signal& Biomedical Image Processing – John L Semmlow, Dekker Media

Course Outcome (COs):

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

1. Reminisce the basics of biomedical signal processing using MATLAB (PO-1,2,4 &PSO-1)
2. Accent the design and implementation of various signal processing techniques and apply the same to biomedical signals. (PO-3,12 & PSO-1,3)
3. Relate the results obtained to the concepts of biomedical signal processing so as to obtain a better understanding of the same (PO-9,12 & PSO-1)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool:	**Marks**	**Course Outcomes Addressed**
Internal test-1	20	CO1,CO2 & CO3
Other components		
Record	10	CO1,CO2 & CO3
Observation	10	CO1,CO2 & CO3
Virtual Lab	10	CO1,CO2 & CO3
Semester End Examination (SEE)	50	CO1,CO2 & CO3

ABILITY ENHANCEMENT COURSE –IV: TELEMEDICINE	
Course Code: MDAEC49	**Credits : 1:0:0**
Prerequisite: Nil	**Contact Hours: 14**
Course Coordinator: Dr. Uma Arun and Dr. Sweeti	

Course Contents

Unit I

Origin and development: Introduction, Definition, Telemedicine in developed and under developed countries, The future of telemedicine.

- **Pedagogy / Course delivery tools:** Chalk and talk.
- **Links:** https://www.youtube.com/watch?v=jZX7nQGScNM https://vdoc.pub/documents/essentials-of-telemedicine-and-telecare-6bigcbklk480

Unit II

Scope, benefits and limitations of telemedicine: Introduction, Types of Telemedicine, Benefits and Limitations of Telemedicine.

- **Pedagogy / Course delivery tools:** Chalk and talk.
- **Links:** https://www.youtube.com/watch?v=w4t1-WpiYsg https://vdoc.pub/documents/essentials-of-telemedicine-and-telecare-6bigcbklk480

Unit III

Technology of Telemedicine Systems: Introduction, Information Types and Transmission, Types of Telemedicine Information, Text and Data, Audio.

- **Pedagogy / Course delivery tools:** Chalk and talk.
- **Links:** https://www.youtube.com/watch?v=EZvjLsIUwag https://vdoc.pub/documents/essentials-of-telemedicine-and-telecare-6bigcbklk480

Unit IV

Telecommunications: Public Switched Telephone Network, ISDN, Satellite, Wireless Technologies, Dedicated Wide Area Connections.

- **Pedagogy / Course delivery tools:** Chalk and talk.
- **Links:** https://www.youtube.com/watch?v=fukXUnLVCuE https://vdoc.pub/documents/essentials-of-telemedicine-and-telecare-6bigcbklk480

Unit V

Telemedicine Service Providers: Introduction, Mainstream Health Sector Services, Ambulance Services, Pharmacy Services.

- **Pedagogy / Course delivery tools:** Chalk and talk.
- **Links:** https://www.youtube.com/watch?v=CxB0S79jVi8 https://vdoc.pub/documents/essentials-of-telemedicine-and-telecare-6bigcbklk480

Text Books:

1. Norris, A.C. "Essentials of Telemedicine and Telecare", Wiley (ISBN 0-471-53151-0), First edition, 2002.
2. Bernard Fong, A.C.M. Fong, C.K. Li, Telemedicine Technologies: Information Technologies in Medicine and Telehealth, John Wiley & Sons, 2011

Course Outcomes (COs):

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

1. Demonstrate an understanding of Origin and development of telemedicine. (PO-1,2; PSO-1)
2. Comprehend and interpret the Scope, benefits and limitations of telemedicine (PO-1; PSO-1)
3. Comprehend and interpret the various techniques involved in the Technology of Telemedicine Systems (PO-1,3; PSO-1)
4. Identify the various types of Telecommunications (PO-2; PSO-1)
5. Analyze the various Telemedicine Service Providers. (PO-1,3; PSO-1)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool:	**Marks**	**Course Outcomes Addressed**
Internal test-1	30	CO1,CO2 & CO3
Internal test-1I	30	CO4 & CO5
Average of the two internal tests shall be taken for 30 marks.		
Other components		
Assignment	10	CO1,CO2
Quiz	10	CO3, CO4 & CO5
Semester End Examination (SEE)	50	CO1,CO2 , CO3, CO4 & CO5

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

Course Contents

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

Course Assessment and Evaluation:

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