ಬಿ.ಎಂ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ, ಬೆಂಗಳೂರು

(ಸ್ವಾಯತ್ತ ವಿದ್ಯಾ ಸಂಸ್ಥೆ)

ಬುಲ್ ಟೆಂಪಲ್ ರಸ್ತೆ, ಬೆಂಗಳೂರು – ೫೬೦ ೦೧೯

B.M.S. COLLEGE OF ENGINEERING

(Autonomous Institute, under VTU)

DEPARTMENT OF

MEDICAL ELECTRONICS ENGINEERING

Scheme and Syllabus

III-VIII Semesters

(For the UG Batch 2021-2025)

DEPARTMENT VISION & MISSION

VISION

To promote quality education in Medical Electronics Engineering for health and well-being of humankind through teaching and research platforms.

MISSION

The department will achieve the Vision through:

M1	Provide professional education in Medical Electronics Engineering, through Curriculum design and its effective implementation for holistic development.
M2	Cater to the current healthcare-necessities of the society, through innovation and research in collaboration with Healthcare providers, Industry, Academia and Alumni.
M3	Emphasis on professional ethics, contribution to society and concern for sustainable environment.

Program Educational Objectives (PEOs)

PEO1	Graduates will build career in Medical Electronics Engineering and allied disciplines.
PEO2	Graduates will pursue higher education and/or engage in continuous up gradation of their professional skills.
PEO3	Graduates will communicate effectively and demonstrate professional behavior while working in diverse teams.
PEO4	Graduates will exhibit concern for society, sustainable environment, and ethical behavior.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1	Formulate, Design, Analyze and demonstrate applications of Electronics in building Biomedical Systems.
PSO2	Specify architect and prototype health-care solutions by applying Biosignal and Medical Image Processing techniques.
PSO3	Design, Develop, Verify processes and Algorithms for Healthcare Applications.

PROGRAMME 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 modelling 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.

Credit Distribution of the UG Program - Medical Electronics Engineering

Curricular Component/ Semester	I	II	III	IV	V	VI	VII	VIII	Total
Basic Science Course (BS)	8	8	3	3			1		23
Engineering Science Course (ES)	10	10	2						22
Professional Core Course (PC)			14	15	16	11	4		60
Professional Elective Course (PE)					3	3	3	3	12
Open Elective Course (OE)						3	3	3	9
Project/ Mini-Project (PW)					2	2	3	6	13
Seminar on Internship (SR)				1		1		4	6
Humanities and Social Sciences, Management Course (HS)	1	1	2	2	1	2	2		11
Ability Enhancement Course / Mandatory Course (AEC)	1	1	1	1					4
Non-Credit Mandatory Course (NCMC)	--	--	NC	NC	NC	NC	NC	NC	6 units
Total Credits	20	20	22	22	22	22	16	16	160

COURSE TYPES: -

Basic Science Course	BS
Engineering Science Course	ES
Professional Core Course	PC
Professional Elective Course	PE
Open Elective Course	OE
Project/ Mini-Project	PW
Seminar –Internship	SR
Humanities and Social Sciences, Management Course	HS
Non-Credit Mandatory Course	NCMC

SCHEME OF STUDY

III Semester Scheme:

Course Code	Course Title	Type	L:T:P	Credits	Hours	CIE	SEE	Total
22MA3BSTFN	Transform Calculus, Fourier Series And Numerical Techniques	BS	2:1:0	3	4	50	50	100
22MD3ESHAP	Human Anatomy and Physiology	ES	2:0:0	2	2	50	50	100
22ES3PCDCS	Digital Circuits	PC	3:0:1	4	5	50	50	100
22ES3PCNAL	Network Analysis	PC	2:1:0	3	4	50	50	100
22MD3PCBSM	Biomedical Sensors and Measurements	PC	2:0:1	3	4	50	50	100
22ES3PCAME	Analog Microelectronics	PC	3:0:1	4	5	50	50	100
22MD3AEPPB	Python Programming for Biomedical Engineers	AE	0:0:1	1	2	50	50	100
22CV3HSEVS	Environmental Studies	HS	1:0:0	1	1	50	50	100
22MA3HSCPH	Constitution of India, Professional Ethics and Human Rights	HS	1:0:0	1	1	50	50	100
22MD3NCPYA	Physical Activity	NCMC	-----	-----	----	P/NP	----	----
Total			**16:2:4**	**22**	**28**	**450**	**450**	**900**

IV Semester Scheme:

Course Code	Course Title	Type	L:T:P	Credits	Hours	CIE	SEE	Total
22MA4BSCPS	Complex Analysis, Probability and Statistical Methods	BS	2:1:0	3	4	50	50	100
22MD4PCPCS	Physiological Control system	PC	2:1:0	3	4	50	50	100
22MD4PCDTE	Diagnostic and Therapeutic Equipments	PC	3:0:1	4	5	50	50	100
22ES4PCAPP	ARM Processor and Programming	PC	3:0:1	4	5	50	50	100
22ES4PCLIC	Linear Integrated circuits	PC	3:0:1	4	5	50	50	100
22MD4SRIN1	Seminar on Internship	SR	0:0:1	1	2	50	50	100
22MA4HSUHV	Universal Human Values	HS	0:1:0	1	2	50	50	100
22MD4AEOOP	Object Oriented Programming	AE	0:0:1	1	2	50	50	100
22MA4HSSAK 22MA4HSBAK	Samskrutika Kannada / Balake Kannada	HS	1:0:0	1	1	50	50	100
22MD4NCCLA	Cultural Activity	NCMC	----	----	----	P/NP	----	----
Total			**14:3:5**	**22**	**30**	**450**	**450**	**900**

V Semester Scheme

Course Code		Course Title	Type	L:T:P	Credits	Hours	CIE	SEE	Total
22MD5PCESD		Embedded System Design	PC	2:1:0	3	4	50	50	100
22MD5PCSGP		Signal Processing	PC	3:0:1	4	5	50	50	100
22MD5PCDSA		Data Structures and Algorithms	PC	2:0:1	3	4	50	50	100
22MD5PCMIM		Medical Imaging Modalities	PC	3:0:0	3	3	50	50	100
22MD5PCMDI		Medical Data Communication and Informatics	PC	2:1:0	3	4	50	50	100
**22MD5PE1XX	VL	VLSI Design	PE-1	3:0:0	3	4	50	50	100
	MW	Mobile and Web Application Development							
22MD5PWPJ1		Project-1	PW	0:0:2	2	4	50	50	100
22MD5HSBWM		Biomedical Waste Management	HS	0:1:0	1	2	50	50	100
22MD5NCHVL		Human Values through Literature	NCMC	----	--	P/NP	----	----	-----
Total				15:3:4	22	30	400	400	800

Program Electives will have an integrated Lab and will be conducted as 2-0-1 (2 Hrs theory and a Lab session per week)

VI Semester Scheme

Course Code		Course Title	Type	L:T:P	Credits	Hours	CIE	SEE	Total
22MD6PCMIP		Medical Image Processing	PC	3:0:1	4	5	50	50	100
22MD6PCMLM		Machine Learning for Medical Engineering	PC	2:0:1	3	4	50	50	100
22MD6PCBSP		Biomedical Signal Processing	PC	3:1:0	4	5	50	50	100
**22MD6PE2XX	WI	Wearable Sensors and Medical IoT	PE-2	3:0:0	3	4	50	50	100
	CD	Clinical Data Analytics							
22MD6OE1XX	CV	Computer Vision	OE-1	3:0:0	3	3	50	50	100
	WS	Wearable Sensors							
	ER	Ergonomics							
22MD6PWPJ2		Project -2	PW	0:0:2	2	4	50	50	100
22MD6SRIN2		Seminar on Hospital Internship	SR	0:0:1	1	2	50	50	100
22ES6HSIPL		IPR and Cyber laws	HS	2:0:0	2	2	50	50	100
22MD6NCPDC		Personality Development and Communication	NCMC	--	--	P/NP	--	--	---
Total				**16:1:5**	**22**	**29**	**400**	**400**	**800**

- ***Program Electives will have an integrated Lab and will be conducted as 2-0-1 (2 Hrs theory and a Lab session per week)***

VII Semester Scheme

Course Code		Course Title	Type	LT:P	Credits	Hours	CIE	SEE	Total
22MD7BSBME		Biology for Medical Electronics Engineers	BS	0:1:0	1	2	50	50	100
22MD7PCMDD		Medical Device Development	PC	3:1:0	4	5	50	50	100
22MD7PE3XX	BR	Biomechanics and Rehabilitation Engineering	PE-3	3:0:0	3	3	50	50	100
	IP	Advanced Image Processing							
22MD7OE2XX	MI	Medical Informatics	OE-2	3:0:0	3	3	50	50	100
	ES	Embedded System Design							
	DS	Data Science for Engineering Applications							
22MD7PWPJ3		Project -3	PW	0:0:3	3	6	50	50	100
22MD7HSBPF		Biomedical Project Management and Finance	HS	2:0:0	2	2	50	50	100
22MD7NCMOC		MOOC -1	NCMC	---	----	---	P/NP	------	-----
Total				**11:2:3**	**16**	**21**	**300**	**300**	**600**

VIII Semester Scheme

Course Code		Course Title	Type	L:T:P	Credits	Hours	CIE	SEE	Total
22MD8PE4XX	BA	Biomaterials and Artificial Organs	PE-4	3:0:0	3	3	50	50	100
	BC	Brain Computer Interface							
22MD8OE3XX	AI	Artificial Intelligence for Healthcare	OE-3	3:0:0	3	3	50	50	100
	FR	Fundamentals of Robotics							
	NE	NanoElectronics							
22MD8PWMPJ		Major Project	PW	0:0:6	6	12	50	50	100
22MD8SRIN3		Seminar on Industry Internship	SR	0:0:4	4	8	50	50	100
22MD8NCMOC		MOOC -2	NCMC	---	----	---	P/NP	------	-----
Total				6:0:10	16	26	200	200	400

III

Semester Syllabus

Medical Electronics Engineering | 2021-25

(COMMON TO ALL BRANCHES EXCEPT CS, IS AND AI & ML)

Course Title	TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES	Course Code	22MA3BSTFN
Credits	**03**	**L – T – P**	**2-1-0**
Contact Hours	**40**		

COURSE OBJECTIVES: The purpose of the course is to facilitate the learners to:

- Appreciate the importance of Series, Transforms and Numerical Techniques in Engineering Problems.
- Acquire the knowledge of Series, Transforms and Numerical Techniques to apply them in their core domain.
- Improve their Mathematical thinking and acquire skills required for sustained lifelong learning.

TEACHING-LEARNING PROCESS (General Instructions):

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Encourage the students for group learning to improve their creative and analytical skills.

UNIT-1

LAPLACE TRANSFORMS: **[08 hours]**

Definition and Laplace transforms of elementary functions (statements only). Problems on Laplace transform of $e^{at} f(t)$, $t^n f(t)$, $\frac{f(t)}{t}$. Laplace transforms of derivatives and integrals. Laplace Transform of periodic functions (statement only) and unit-step function – Problems. Inverse Laplace transforms: definition and problems. solution of differential equations.

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT-2

FOURIER SERIES: **[08 hours]**

Introduction to infinite series, convergence and divergence. Periodic functions, Dirichlet's conditions. Fourier series of periodic functions with period 2π and arbitrary period. Complex Fourier series. Practical harmonic analysis.

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT-3

FOURIER TRANSFORMS: **[08 hours]**

Definition and problems on Fourier Transform. Fourier sine and cosine transforms – Problems.

Inverse Fourier transform, Inverse Fourier cosine and sine transforms - Problems. Convolution theorem (only statement) – problems.

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT-4

NUMERICAL SOLUTION OF PDE: **[08 hours]**

Classification of second-order partial differential equations, finite difference approximation of derivatives. Solution of one-dimensional heat equation by Schmidt explicit formula and Crank- Nicholson method. Solution of one-dimensional wave equation using explicit three level formula and implicit scheme.

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT-5

CALCULUS OF VARIATIONS: **[08 hours]**

Definition, Variation of a functional, Euler's equation, variational problems.

Applications: Hanging cable problem, Brachistochrone problem.

Z-TRANSFORMS:

Definition, Standard Z-transforms, Damping rule, Shifting rule, Initial value and final value theorems-problems. Inverse Z-transform and applications to solve difference equations.

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

Course outcomes (Course Skills Set)

After successfully completing the course, the student will be able to understand the topics:

Course Code	CO	COURSE OUTCOME (CO)	PO	Strength
22MA3BSTFN	**CO 1**	Apply the concepts of Transform Techniques, optimization and Finite Difference Methods to solve engineering	1	3

		problems.		
	CO 2	Analyze Engineering Application Problems using the concepts of Transform Techniques, optimization and Finite Difference Methods.	1	1
	CO 3	Demonstrate the importance of Transform Techniques, optimization and Finite Difference Methods in engineering using programing tools.	1 & 5	1

Assessment Details (both CIE and SEE)

Component	Type of assessment	Max. Marks	Total	50 % Weightage	Total
CIE – Theory	Quiz	10	100	5	50
	AAT	10		5	
	Test 1	40		20	
	Test 2	40		20	
	Test 3	40		20	
SEE	End Exam	100		50	

Two best scores out of the three tests will be considered for CIE.

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

SEMESTER END EXAMINATION:

- Each unit consists of one full question.
- Five full questions to be answered.
- To set one question each from Units 2, 3 & 4 and two questions each from Unit 1 and Unit 5.

SUGGESTED LEARNING RESOURCES:

TEXT BOOKS:

1. B. S. Grewal: "Higher Engineering Mathematics", Khanna publishers, 44th Ed.2018
2. E. Kreyszig: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed. (Reprint), 2016.

REFERENCE BOOKS:

1. B.V. Ramana: "Higher Engineering Mathematics", McGraw-Hill Education, 11th Ed.
2. Srimanta Pal & Subodh C. Bhunia: "Engineering Mathematics "Oxford University Press, 3rd Reprint, 2016.
3. N. P Bali and Manish Goyal: "A textbook of Engineering Mathematics", Laxmi Publications.

4. C. Ray Wylie, Louis C. Barrett: "Advanced Engineering Mathematics", McGraw–Hill Book Co. New York, 6th Edition.
5. Gupta C.B, Sing S. R. and Mukesh Kumar: "Engineering Mathematic for Semester I and II", Mc- Graw Hill Education (India) Pvt. Ltd 2015.
6. H. K. Dass and Er. Rajnish Verma: "Higher Engineering Mathematics", S. Chand Publication (2014).
7. James Stewart: "Calculus" Cengage publications, 7th edition, 4th Reprint 2019.

WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. http://www.class-central.com/subject/math(MOOCs)
2. http://academicearth.org/
3. http://www.bookstreet.in.
4. VTU e-Shikshana Program
5. VTU EDUSAT Program

Semester	III			
Course Title	**Human Anatomy and Physiology**	**Course Code**	**22MD3ESHAP**	
Credits	2	**L-T-P**	**2:0:0**	**Total Hours: 25**
Pre Requisites: Basic concepts of Biological Science.				
Course Outcomes: At the end of the course students will be able to,				
CO1	Apply the knowledge of science and engineering of human anatomy and physiology to arrive at solutions for physiological problems.			
CO2	Identify and analyze problems related to human anatomical systems and their typical features.			
CO3	Analyze the processes for physiological problems considering health and safety of human beings			
CO4	Use literature survey based knowledge to interpret data of contemporary investigations and demonstrate the same.			
CO5	Communicate and document the outcome of working individually and in team for the survey conducted.			

CO-PO-PSO-Mapping:- 22MD3ESHAP

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2		3											3		
CO3		3											3		
CO4				2									2		
CO5									2	2			2		
Avg.	**3**	**3**		**3**					**2**	**2**			**3**		

UNIT 1	
Metabolic system: The Cell, Functions of the Cell Membrane, Movement across the Cell Membrane: Different mechanisms. Action potentials, Homeostasis, Controls and Feedbacks. Metabolic Rate: Definition, Methods of determination of Metabolic Rate: Direct and Indirect methods, Respiratory Quotient (RQ): Measurement of RQ, BMR; Factors influencing BMR.	5Hrs
UNIT 2	
Cardiovascular system: Electrophysiological properties of heart, Frank Starling Mechanism, Heart as Pump, Pressure and Volume changes during a Cardiac cycle, Work done by the Heart. Mechanism of Control of Heart Rate, Conditions affecting the Heart Rate, Blood Pressure, Clinical Electrocardiography, Hypertension. Pathological conditions: Stock-Adam's Syndrome.	6Hrs
UNIT 3	
Respiratory system: Anatomy of respiratory system with special reference to anatomy of lungs, Ventilation and its mechanism: Intra Pleural Pressure, Compliance and factors affecting it. Role of chest wall, Airway resistance, Work done in Breathing, Alveolar Ventilation, Ventilation Perfusion Ration. Discussion on Hypoxia, High Altitude Sickness, Pulmonary Edema, Asthma, Sleep Apnea, ARDS, Lung Function Tests: Spirometry, Lung Volumes and Lung Capacities.	5 Hrs
UNIT 4	
Skeletal, Muscular and Nervous System: Skeletal muscle: Contraction and relaxation, Neuromuscular junction: Receptors, transmissions. Characteristics and Properties of Skeletal muscles. Smooth muscle; properties of smooth muscle, Neuro effector junction, Electrophysiological properties. **Nervous system:** Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, electrophysiology, action potential, nerve impulse, receptors, synapse, neurotransmitters.	5 Hrs
UNIT 5	
Endocrine, Urinary and Reproductive System: Urinary system: Anatomy of urinary tract with special reference to anatomy of kidney and nephrons, functions of kidney and urinary tract, physiology of urine formation, micturition reflex and role of kidneys in acid base balance, role of RAS in kidney and disorders of kidney. **Endocrine system:** Classification of hormones, mechanism of hormone action, structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas, pineal gland, thymus and their disorders.	6 Hrs
Text Books	
1 Principles of anatomy and physiology, Gerard j. Tortora, Bryan derrickson, 13th Edition, john Wiley & sons, Inc.	

2	Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers medical publishers, New Delhi.	
Reference Books:		
1	Text book of Medical Physiology- Arthur C,Guyton andJohn.E. Hall. Miamisburg, OH, U.S.A.	
2	Hole's human anatomy & physiology, David n. Shier, Jackie l. Butler, ricki Lewis, isbn-13: 978-0078024290, McGraw-Hill education; 14th Edition.	
Online courses:		
1	Unit 1: https://oli.cmu.edu/jcourse/webui/syllabus/module.do?context=0477224b0a0001dc579a352e89762e86	
2	Unit 2: https://oli.cmu.edu/jcourse/webui/syllabus/module.do?context=0477212a0a0001dc3adf3212071a87ed	
3	Unit 3: https://oli.cmu.edu/jcourse/webui/syllabus/module.do?context=047720430a0001dc408737120e19098a	
4	Unit 4: https://oli.cmu.edu/jcourse/webui/syllabus/module.do?context=04771e380a0001dc6a6e5999efc27662	
5	Unit 5: https://oli.cmu.edu/jcourse/workbook/activity/page?context=04771fb00a0001dc654345b7b912c029&view=frameset	
E-Books:		
1	https://openstax.org/details/books/anatomy-and-physiology-2e	
2	https://open.umn.edu/opentextbooks/textbooks/fundamentals-of-anatomy-and-physiolog	

Medical Electronics Engineering 2021-25

(Common to EEE, ETE, Med.Elns and EIE)

Semester	III			
Course Title	**DIGITAL CIRCUITS**	**Course Code**	**22ES3PCDCS**	
Credits	4	**L-T-P**	**3:0:1**	Total Hours: 40
Pre Requisites: Basic Electronics				
Course Outcomes: At the end of the course students will be able to,				
CO1	Apply the knowledge of simplification and optimization of digital concept.			
CO2	Analyze digital circuits to reach substantiated conclusion.			
CO3	Design and simulate digital circuits to meet the given specification.			
CO4	Work individually/ in a team to demonstrate an open-ended experiment and document the same.			
CO5	Conduct experiments using digital IC and simulation tools for a given problem statement.			

CO-PO-PSO-Mapping:- 22ES3PCDCS

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2		3											3		
CO3			3										3		
CO4			2		2				2	2			2		
CO5				3	3								3		
Avg.	**3**	**3**	**3**	**3**	**3**				**2**	**2**			**3**		

UNIT 1	
Introduction: Review of Boolean algebra, logic gates. **Simplification of Boolean functions:** Three Variable, Four Variable-K– Maps, The Tabulation Method, Design with Basic gates, NAND gates and NOR gates. **Introduction to Verilog:** Structure of Verilog module, Operators, Data Types, Styles of Descriptic Introduction to test bench.	8Hrs
UNIT 2	
Arithmetic Circuits: Introduction, Half adder, Half subtractor, Full adder, Full subtractor, Parallel Adders (Carry Look Ahead Adder and Ripple carry adder), Decimal Adder. **Verilog Data flow description:** Highlights of Data flow description, Structure of Data flow description.	8Hrs
UNIT 3	
Combination Logic Circuits: Code conversion, Magnitude Comparator, Decoders, Multiplexers, Read Only memories (ROM), Programmable Logic Arrays (PLAs). Modeling using data flow description.	8Hrs

UNIT 4		
Sequential Logic Circuits: The Basic Flip-flop circuit, Clocked Flip-flops, Triggering of Flip-flops: Master Slave Flip-Flops, Edge Triggered Flip Flops, Characteristic Equations, Conversion of flip-flops. **Verilog Behavioral description:** Structure, Variable Assignment Statement, Sequential Statements, Loop Statements, Verilog Behavioral Description of Combinational and Sequential Circuits.		8Hrs
UNIT 5		
Verilog Structural description: Highlights of Structural description, Organization of structu description, Structural description of Combinational and Sequential Circuits- Shift Registers, Ripp Counters, Synchronous Counters.		8Hrs
Text Books		
1	Digital Logic and Computer Design- M. Morris Mano, Prentice Hall – Pearson Education	
2	Verilog HDL –Samir Palnitkar	
3	Digital Principles and Design- Donald Givone, Tata Mc Graw Hill	
Reference Books:		
1	Digital Design : Principles and Practices 4th Edition,John F. Wakerly	
2	Fundamental of Logic Design- Charles Roth Jr., Thomas Learning	
3	Digital Logic Applications and principles- John Yarbrough, Pearson Education	
4	HDL Programming VHDL and Verilog by Nazeih M Botros, 2009 reprint, Dreamtech press.	
Online courses:		
1	https://nptel.ac.in/courses/108105113/	
2	https://nptel.ac.in/courses/Verilog fundamentals	
E-Books:		
1. http://www.panstanford.com/pdf/9789814364591fm.pdf 2. https://easyengineering.net/digital-logic-and-computer-design-by-morris-mano/ 3. https://www.sciencedirect.com/book/9780750645829/digital-logic-design 4. https://easyengineering.net/fundamentals-of-digital-circuits-by-anand-kumar/		
Lab Component:		

List of Experiments: –

	Title of the Experiment
1	Applications of IC 7483 (Adders, Subtractors and Comparators)
2	Multiplexers (using Gates and IC) and their applications.
3	Decoders/DeMultiplexers (using Gates and IC) and their applications.
4	BCD to Decimal decoder using 7-segment display.
5	Verification of MSJK Flip-flop (using Gates and IC 7476).
6	Asynchronous counters (using ICs 7476,7490,7493).
7	Synchronous Counters (using ICs 7476, 74190/74192).
8	Shift registers and their applications (using ICs 7476, 7495).

All experiments to be conducted using digital IC trainer kit and simulator

(Common to E&C and Med.Elns Engg)

Semester	3			
Course Title	Network Analysis	**Course Code**	22ES3PCNAL	
Credits	3	**L-T-P**	**2:1:0**	Total Hours: 25
Pre Requisites: Basic Electrical Engineering, Engineering Mathematics.				
Course Outcomes				
CO1	Apply the knowledge of mathematics and analytical techniques to analyze the electrical networks			
CO2	Formulate equations based on physical laws and theorems for the analysis of electric circuits.			
CO3	Apply mathematical and analytical techniques to analyze circuits and systems in time and frequency domain.			
CO4	Evaluate the electrical circuit using modern tools for comparative study			
CO5	Document and present the comparative study of practical and theoretical implementation of electrical circuits			

CO-PO-PSO-Mapping:-22ES3PCNAL															
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2		3											3		
CO3	3												3		
CO4					2								2		
CO5									2	2			2		
Avg.	**3**	**3**			**2**				**2**	**2**			**3**		

UNIT 1	
Basic Concepts: Active and passive elements, Concept of ideal and practical sources. Source transformation and Source shifting, Concept of Super-Mesh and Super node analysis. Analysis of networks by (i) Network reduction method including star – delta transformation, (ii) Mesh and Node voltage methods for AC and DC circuits with independent and dependent sources	8Hrs
UNIT 2	
Network Theorems: Super Position theorem, Reciprocity theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem.	8Hrs
UNIT 3	
Resonant Circuits: Analysis of simple series RLC and parallel RLC circuits under resonances. Problems on Resonant frequency, Bandwidth and Quality factor at resonance.	7Hrs
UNIT 4	
Laplace Transformation: Laplace transformation (LT), LT of Impulse, Step, Ramp, Waveform synthesis. Initial and Final value theorems. Solution for RL, RC networks for DC excitation. **Transient Analysis:** Transient analysis of RL and RC circuits under DC excitations: Behavior of circuit elements under switching action (t=0 and t=∞), Evaluation of initial conditions	8Hrs
UNIT 5	
Two Port networks: Definition, Open circuit impedance, short circuit admittance, hybrid and Transmission parameters. Relation between the different parameters. Evaluation of electrical circuits for Independent sources only.	8Hrs

Text Books		
1	Engineering Circuit Analysis William H Hayt et al. Mc Graw Hill 8th Edition, 2014.	
2	Circuit Theory Analysis and Synthesis Chakrabarti, A Dhanpat Rai & amp Co. Seventh – Revised edition, 2018	
Reference Books:		

1	Networks and systems. D. Roy Choudhary New Age International Publishers	
Online courses:		
1	Provide Unit wise online course or for entire syllabus	
2	https://www.coursera.org/courses?query=circuit%20analysis	
3	https://www.coursera.org/courses?query=network%20analysis&languages=de	
E-Books:		
1	https://b-ok.asia/book/2050320/7e774a	
2	https://b-ok.asia/book/1188635/3ce180?dsource=recommend	

Semester	III			
Course Title	Biomedical Sensors and Measurements	**Course Code**	22MD3PCBSM	
Credits	3	**L-T-P**	2-0-1	**Total Hours:25**
Pre-Requisites: Basic Principles of physics, chemistry and measurements.				
Course Outcomes: At the end of the course students will have ability to				
CO1	Apply the knowledge of the physical principles for sensing, and the concepts of engineering to design measurement systems and evaluate their performance characteristics.			
CO2	Identify and analyse engineering problems to arrive at suitable techniques for the measurement of physical and biomedical parameters.			
CO3	Design solutions by recognizing sensors and electrodes for the given requirements, appropriately considering the health and safety of human beings.			
CO4	Conduct experiments on biomedical sensors to assess specific parameters, interpret, analyse and document the test results.			
CO5	Work with sensors and biomedical measurement systems both individually and in teams, document the activity and communicate the outcome to an engineering community.			

CO-PO-PSO-Mapping:-22MD3PCBSM															
Course outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3					2							3		
CO2		3											3		
CO3			3										3		
CO4				3						3			3		
CO5	3								2	3		3	3		
AVG	**3**	**3**	**3**	**3**		**2**			**2**	**3**		**3**	**3**		

UNIT 1	
Introduction to Measurements: Introduction, Classification of Instruments based on applications, Performance Characteristics of measuring instruments: Static Characteristics, Dynamic Characteristics – Overview. Measurement Errors. Units of Measurement Quantities- SI – Base units and derived units – Overview.	4Hrs
UNIT 2	
Sensors and Classification: Definition, Classification as Mechanical and Electrical, Active and Passive sensors. Types of Active sensors – Basic Theory with examples: Resistive – Catheter Tip Strain Gauges, Capacitive – Displacement sensor, and Inductive – LVDT for physiological pressure measurement. Passive Sensors – Piezoelectric crystals. Desirable Characteristics of Sensors. Biomedical Signals – Parameters, Typical ranges and Sensors.	6Hrs
UNIT 3	
Temperature and Heat flow Measurements: Units of Thermal quantities, Body and skin temperatures, Sensors – RTDs, Thermistors, Thermocouples, p-n junction diodes and transistors, Examples of Integrated circuits sensing devices. Non-contact techniques: Infrared radiation thermometers, Infrared detectors. zero-heat-flow thermometer for deep tissue temperature measurement. Radio-pill for core body temperature.	6Hrs
UNIT 4	
Bioelectric and Biomagnetic Measurements: Units, Action potential generation, Bioelectric events. Electrode theory, liquid junction potentials, Double layer, Electrode potential. Surface potential electrodes: ECG electrodes – Ag-AgCl, Stainless steel, Dry electrodes, Electrode impedance, Motion Artifacts. ECG – Einthoven's triangle, standard 12-lead system. EMG electrodes – Surface electrodes, EEG electrodes and 10-20	5Hrs

electrode system, unipolar, bipolar and average modes. EMG– unipolar and bipolar mode. Biomagnetism – Fields, Fluxgate Magnetometer and types.		
UNIT 5		
Chemical Measurements: Units, Objects, requirements and limitations. Chemical sensors : Potentiometric Sensors - Ion-selective FET. Electrochemical – CO2 electrode and Zirconia oxygen sensor, Impedimetric sensors. Optically based chemical sensors – Spectrophotometric. Chemical Analysis, Biosensors, Immunosensors, and DNA sensors – Overview with examples.		4Hrs
Text Books		
1	B C Nakra and K K Chaudhry, Instrumentation Measurement and Analysis, 3-e, McGraw Hill, 2009	
2	Tatsuo Togawa, Toshiyo Tamura, P. Ake Oberg, Biomedical sensors and Instruments, 2-e, CRC Press, 2011	
Reference Books:		
1	R.S. Khandpur, Handbook of Biomedical Instrumentation, 3-e, McGraw Hill, 2014	
2	D.V.S Murthy, Transducers and Instrumentation, 2-e, PHI, 2009	
Online courses:		
1	https://skill-lync.com/medical-technology-courses/medical-instrumentation-biomedical-signals	
2	https://ep.jhu.edu/courses/585613-medical-sensors-devices/	
E-Books:		
1	https://www.acsce.edu.in/acsce/wp-content/uploads/2020/03/Biomedical-Sensors-Instruments.pdf	
2	https://www.intechopen.com/chapters/48226	
Lab Component :		
List of Experiments: – 1. Characteristics of RTD, Thermistor and Thermocouples 2. Dynamic response of first order system 3. Dynamic response of second order system 4. Force/Pressure measurement using Strain Gauges 5. Temperature Measurement using AD590 & LM35 6. ECG, EMG and EEG acquisition 7. Electrochemical Sensor characteristics 8. Measurements using pH Sensor		

Medical Electronics Engineering | 2021-25

(Common to Med.Elns and EIE)

Semester	III			
Course Title	Analog Microelectronics	**Course Code**	22ES3PCAME	
Credits	4	**L-T-P**	3-0-1	**Total Hrs**:40
Pre-Requisites: Basic concepts of Trigonometry, methods of differentiation, methods of integration, solution of ordinary differential equations.				
Course Outcomes: At the end of the course the students will be able to,				
CO1	Apply the Network concepts to obtain solutions to analog electronic circuits of BJTs and MOSFETs.			
CO2	Analyse analog electronic circuits of BJTs and MOSFETs for given specifications.			
CO3	Design solutions of engineering problems and system components for the specific needs.			
CO4	Design and Conduct experiments by discrete components and Modern tools. Demonstrate, document and Present a report.			
CO5	Formulate and implement open ended experiment. Document and present the same in a Team.			

CO-PO-PSO-Mapping:-22ES3PCAME

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2		3											3		
CO3			3										3		
CO4				3	3								3		
CO5		2	2						2	2		2	2		
AVG	**3**	**3**	**3**	**3**	**3**				**2**	**2**		**2**	**3**		

UNIT 1	
Diode applications: - Introduction, load line analysis, Series diode configurations, Parallel and series –parallel configurations, clippers, Clampers. **Bipolar Junction Transistor (BJTs):-** DC biasing– Introduction , operating point voltage divider Bias configuration **BJT AC Analysis :-** Introduction , Application in the AC Domain, BJT Transistor Modeling, the r_e Transistor model ,Voltage Divider Bias .	8Hrs
UNIT 2	
BJT Frequency Response :- Introduction, Logarithms, Decibels , Low frequency Response-BJT Amplifier, Miller effect Capacitance, High Frequency response – BJT Amplifier **Feedback concepts:-** Feedback connection types- Voltage series, Voltage-shunt , Current Series and Current Shunt Feedback.	8Hrs
UNIT 3	

Power Amplifiers:- Introduction- Definitions and Amplifier Types, Amplifier Efficiency **Series-Fed Class A Amplifier**: DC Bias Operation, AC operation, Power Consideration, Efficiency. **Transformer coupled Class A Amplifier :** Operation of Amplifier Stage : DC load line, Quiescent operating point, AC load line , Signal Swing and Output AC power. **Class B operation:** Class B Amplifier Circuits- Transformer coupled Push- Pull Circuits, Complementary Symmetry Circuits, Amplifier Distortion.		8Hrs
UNIT 4		
MOSFETS:- Introduction ,**Device structure and physical operation** ---- Device structure, operation with no gate voltage, creating a channel for current flow, Applying a small VDs, Operation as VDs is increased, Derivation of the id – V_{DS} relationship, The P- Channel MOSFET, Complementary MOS or CMOS, operating the MOS transistor in the sub-threshold region . **Current voltage Characteristics---**Circuit symbol, id – V_{DS} characteristics, characteristics of the P-Channel MOSFET **MOSFET Circuits at DC** **The MOSFET as an amplifier and as a switch** --- Large – signal operation , Graphical derivation of the transfer characteristic, operation as a switch, operation as a linear amplifier. **Biasing in MOS amplifier circuits---**Biasing by fixing V_{GS}, Biasing by fixing V_G and connecting a resistor in the source , Biasing using a drain to gate feedback resistor, biasing using a current source.		8Hrs
UNIT 5		
Small – signal operation and models of MOSFETs---The DC bias point, the signal current in the drain terminal ,the voltage gain, separating dc analysis and the signal analysis, small signal equivalent circuit models, the transconductance g_m, the T equivalent circuit model. **Single stage MOS amplifiers---**The basic structure, characterizing amplifiers, The CS amplifier, The CS amplifier with a source resistance. Common gate (CG) Amplifier, The common Drain or source follower Amplifier. CS Amplifier Frequency Response: High Frequency and Low frequency response. Oscillators: FET based Phase shift oscillator, LC and Crystal Oscillators (no derivation) **IC Biasing**: – **Current sources, current mirror and current steering circuits---** The basic MOSFET current source, MOS current steering circuits **Current mirror circuit with improved performance** --- The Wilson MOS mirror **IC Biasing:** Current sources, current mirror and current steering circuits: The basic MOSFET current source, MOS current steering circuits		**8Hrs**
Text Books:		
1	Electronic Devices and Circuit Theory-Robert L.Boylestad and Louis Nashelsky-10th edition (PEARSON EDUCATION)	

2	Microelectronic Circuits-Theory and applications by Adel S. Sedra And Kenneth C.Smith Fifth Edition (Oxford International Student Edition	
Reference Books:		
1	Electronic Devices and Circuits, S. Salivahanan , N. Sereshkumar , McGraw Hill Education (India) Private Limited, ISBN -9781259051357	
2	Electronic Devices and Circuits- Millman and Halkias, TMH	
3	Electronic Devices and Circuits- David A Bell - PHI 4th edition	
Online courses:		
1	**MOOCs:** https://www.mooc-list.com/course/electronic-systems-and-digital-electronics-uninettuno?static=true	
2	http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-012-microelectronic-devices-and-circuits-spring-2009/	
E-Books:		
1	1. https: //www.mooc-list.com/ course/ electronic-systems-and-digital-electronics-uninettuno?static=true 2. http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-012-microelectronic-devices-and-circuits-spring-2009/ 3. Introductory Analog Electronics Laboratory (Spring 2007) by MIT open courseware Reviews and Ratings	
2	**e-References/URLS:** 1. http://www.allaboutcircuits.com/ 2. http://www.allaboutcircuits.com/videos 3. www.pyroelectro.com/edu/analog 4. http://freevideolectures.com/course/3020/circuits-for-Analog-System-Design	

List of Experiments:

1. Diode and Transistor as a switch.
2. Diode clipping circuits- Single/Double ended
3. Diode clamping Circuits - positive clamping/negative clamping.
4. Design of Power supplies and regulators
5. BJT as RC coupled amplifier.
6. BJT as RC phase shift oscillator, Hartley, Collpits and Crystal Oscillator.
7. Power Amplifier.
8. MOSFET Characteristics
9. MOSFET Amplifier
10. Simulation Experiments.
11. Open Ended Experiments on Biomedical Applications

Medical Electronics Engineering 2021-25

Semester	III			
Course Title	Python Programming for Biomedical Engineers	**Course Code**	22MD3AEPPB	
Credits	1	**L-T-P**	**0-0-1**	Total Hrs: 15
Pre-Requisites: Computer Concepts and C Programming				
Course Outcomes: At the end of the course students will be able to				
CO1	Apply the knowledge of python programming syntax and semantics for control flow statements.			
CO2	Analyze the python flow control and functions to reach substantiated conclusion.			
CO3	Develop and simulate python programs by handling files and strings to meet the given specification.			
CO4	Conduct experiments using core data structure like list, dictionaries and tuples using modern tools.			
CO5	Demonstrate and communicate effectively data science operation and plot various Bio signals individually and in a team.			

CO-PO-PSO Mapping : 22MD3AEPPB

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3													3	
CO2		3												3	
CO3			3											3	
CO4				2	2										2
CO5				3	3				2	2					2
AVG	**3**	**3**	**3**	**3**	**3**				**2**	**2**				**3**	**2**

SYLLABUS	
Getting Started with Python: Overview of Software development, Programming languages, Python and thrust areas of Python, Python Installation and Google Colab. **Introduction to Python Programming:** Need for programming, Keywords and Identifiers, statements and expressions, comments, variables, Data types and type conversion, Input and Output, Operators, Precedence and Associativity, Indentation. **Control Flow Statements:** If else decision control flow, for loop, while loop, continue and break statements, pass keyword, nested statements.	3Hrs
Lists: Creating Lists, Basic List Operations, Indexing and Slicing in Lists, List Methods **String:** Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings **Functions:** Definition and calling the function, Function arguments, Command Line Arguments, return statement, scope and lifetime of variables, recursion, Built in functions, commonly used modules and packages, sorting, binary search	3Hrs
Tuples and Sets: Creating Tuples, Basic Tuple Operations, Indexing and Slicing in Tuples, Relation between Tuples and Lists, Tuple Methods, Sets, Set Methods, Traversing of Sets, frozenset	3Hrs

Files: Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files, The Pickle Module, Reading and Writing CSV Files, Python os and os.path Modules		3Hrs
Introduction to Data science: NumPy and Pandas with Python, Graphs with Matplotlib pyplot: Line Graphs, Scatter Graph, Pie Charts, Bar Charts, Figures and Subplot, 3D Graphs Case Study: Bio-Signal Plotting using Matplotlib/Pandas Library		3Hrs
Text Books		
1	Martin C. Brown, "Python: The Complete Reference", McGraw Hill Education; Fourth edition, 2018	
2	Mark Summerfield, "Programming in Python 3: A Complete Introduction to the Python Language", Pearson Education	
Reference Books:		
1	Zed A. Shaw, "Learn Python The Hard Way: A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code, 3rd edition" , Adisson-Wesley	
2	Erik Westra, "Modular Programming with Python: introducing modular techniques for building sophisticated programs using Python", Packt Publishing	
Online courses:		
1	https://docs.spyder-ide.org/current/index.html	
2	https://wiki.python.org/moin/BeginnersGuide	
3	https://www.programiz.com/python-programming	
E-Books:		
1	https://www.syncfusion.com/succinctly-free-ebooks/python	
2	https://jakevdp.github.io/PythonDataScienceHandbook/?utm_source=devfreebooks&utm_medium=medium&utm_campaign=DevFreeBooks	

Course	Environmental studies	Course Code	22CV3HSEVS	SEE QP Duration	1Hr 30 Mins
Credits	01	L:T:P	1: 0 : 0	SEE marks	50

(3rd & 4th Sem students of cluster Departments)

COURSE OBJECTIVE: The students will be able to develop a sense of responsibility about the environment, natural resources, their conservation and Understand the concept, structure and function of different ecosystems and the ill effects of environmental pollution and other environmental issues like population growth, Acid rain, global warming etc.,

COURSE OUTCOME : Student can an ability to

CO1: Discuss the components and impacts of human activities on environment.

CO2: Apply the environmental concepts for conservation and protection of natural resources.

CO3: Identify and establish relationship between social, economic and ethical values from environmental perspectives.

Unit–1: Introduction to Environment

- Definition, about the Earth, Earth's Structure i.e. Atmosphere and its parts, Hydrosphere, Lithosphere and Biosphere.
- Ecology & Ecosystem, Balanced ecosystem, types of Ecosystem.

03 Hrs

Unit–2: Human Activities on Environment

- Human activities - Food, Shelter, Economic and Social Security.
- Effects of Human activities on Environment:
  - i) Agriculture,
  - ii) Housing,
  - iii) Industries,
  - iv) Mining and
  - v) Transportation activities.
- Environmental Impact Assessment (E I A)
- Sustainable development

03 Hrs

Unit–3: Natural Resources

- Definition, Renewable and Non-Renewable sources.
- Major Natural Resources are -
  - Water resources, its availability, quality, water borne & water induced diseases,
  - Mineral resources, classification, uses in various Industries as byproducts.
  - Forest resources – causes & consequences of deforestation, various afforestation programs.
- Conventional and Non-conventional energy resources -
  - Hydroelectric, Wind power, Solar, Biogas, geothermal energy.
  - Fossil fuel based energy resources – Coal, Oil & Gas, Nuclear power
  - Hydrogen as an alternate future sources of energy.

03 Hrs

Unit–4: Environmental pollution

Introduction, following are few types of pollutions to study -

- Water pollution - definition, types, sources, effects and control of water pollution.
- Land pollution - definition, types, sources, effects, Solid waste management.

- Noise pollution - definition, sources, effects & control of noise pollution.
- Air pollution - definition, sources, effects & control of air pollution.

03 Hrs

Unit-5: Current Environmental Issues & Importance

- Population growth, effects & Control, Climatic changes,
- Global warming, Acid rain, Ozone layer depletion and its effects.
- Environmental protection – initiatives by Government and non–Govt. Organizations (NGO's), Role of Legal aspects.
- Environmental Education, Women education. 03 Hrs

Total contact hours = 15 (Weekly 1 Hr.)

C I E Marks: Conduct 3 Tests, considering best of 2. The pattern of Test paper consists of two parts. Part-A consists of 20 MCQs for 1 mark each; Part-B consists of 3 descriptive questions, 10 marks each. Student should answer 2 full questions from part-B. Two quizzes, each quiz is for 5 marks covering full syllabus.

TOTAL C I E MARKS: 20+20+10=50 MARKS

SEE QUESTION PAPER PATTERN

PART-A

- 20 Multiple Choice Questions Covering full syllabus
- 1 Mark each, students have to attend all questions

PART-B

- Consist of 4 main questions. It may be subdivisions of 3 or 4.
- Each question consists of 10 marks, covering full syllabus
- Student should Answer only 3 full questions.

30 marks

SEE TOTAL MARKS: 20+30=50 MARKS

TEXT BOOKS:

1. Environmental studies by - Dr. Geetha Balakrishna (Revised Edition-Sun star publication)

2. Ecology by – Subramanyam (Tata McGraw Hill Publication)

3. Environmental studies by – Dr. J.P. Sharma (Fourth edition)

4. Environmental studies by – Smriti Srivastav (Published by Kataria & Sons)

REFERENCES:

1. Environmental studies by – Benny Joseph

2. Environmental studies by – Dr. D.L. Manjunath

LEARNING RESOURCES:

1. NPTEL (Open Sources / power point and visuals)

2. Ecological studies / IITR / Open Sources

3. Ministry of Environment and forest & wildlife.

MOOCs:

MOOCS – https://www.coursera.org / course / sustain

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										
CO2	2	2										
CO3	1	1										

Course Code	22MA3HSCPH	Course Name	Constitution of India, Professional Ethics and Human Rights
Credits	01	L-T-P	1-0-0
Total Number of hours		15	

Course Objectives:

The objectives of the course are:

- To educate students about the country's highest law.
- To respect human dignity and protect people's rights from discrimination.
- To discuss about risk management, workplace safety, and increase understanding of concerns pertaining to the profession.

Teaching-Learning Process (General Instructions):

These are sample strategies; which teachers can use to accelerate the attainment of the various course outcomes.

- Innovative lecture methodologies to be adapted to improve the teaching and learning process.
- Short videos for better understanding and group discussion.
- Encourage collaborative (Group Learning) learning in the class.
- Ask Higher Order Thinking (HOT) questions in the class, which promotes critical thinking.
- Classroom discussions focused on case studies to help students strengthen their analytical skills and thinking abilities, such as the capacity to assess, generalise, and analyse knowledge rather than just recollect it.

UNIT-1

Introduction to Indian Constitution **[03 hours]**

Framing of the Indian constitution: Role of the Constituent Assembly - Preamble and Salient features of the Constitution of India, Fundamental Rights and its limitations. Fundamental Duties and their significance. Directive Principles of State Policy: Importance and its relevance.

Case Studies.

Teaching-Learning Process: Chalk and talk method / Power Point Presentation.

UNIT -2

Union Executive and State Executive **[03 hours]**

The Union Executive – The President and the Vice President, the Prime Minister and

The Council of Ministers. The Union Parliament – Lok Sabha & Rajya Sabha.

The Supreme Court of India.

State Executive – The Governors, the Chief Ministers and the Council of Ministers. The State Legislature – Legislative Assembly and Legislative Council. State High Courts.

Teaching-Learning Process: Chalk and talk method / Power Point Presentation.

UNIT -3

Election Commission of India, Amendments and Emergency Provisions [03 hours]

Election Commission of India – Powers & Functions – Electoral Process in India.

Methods of Constitutional Amendments and their Limitations.

Important Constitutional Amendments – 42nd, 44th, 61st, 74th, 76th, 77th, 86th and 91st.

Emergency Provisions. Case Studies.

Teaching-Learning Process: Chalk and talk method / Power Point Presentation

UNIT-4

Human Rights [03 hours]

Human Rights – Meaning and significance, Types Human Rights, Powers and Functions of National and State Human Rights Commission of India. Human rights in constitution of India.

UNIT-5

Professional Ethics [03 hours]

Scope and Aims of Engineering Ethics, Responsibilities of Engineers and impediments to

Responsibilities. Honesty, Integrity and Reliability; Risks – Safety and Liability in

Engineering. Case Studies.

Course Outcomes:

At the end of the course, the student will have the ability to

COURSE CODE	CO#	Course Outcome	PO	Strength
22MA3HSCPH / 22MA4HSCPH	**CO1**	Recognize the significance of the Indian Constitution as the supreme legal authority.	PO6, PO12	3
	CO2	Analyse human rights theories and concepts.	PO6, PO12	3

	CO3	Apply the principles of moral obligations and duties to safeguard the public's welfare and safety.	PO8, PO12	2

Text Books:

1. "An Introduction to Constitution of India and Professional Ethics" by Merunandan K.B. and B.R. Venkatesh, Meragu Publications, 3rd edition, 2011.
2. "Constitution of India & Professional Ethics & Human Rights" by Phaneesh K. R., Sudha Publications, 10th edition, 2016.

Reference Books:

1. "V.N. Shukla's Constitution of India" by Prof (Dr.) Mahendra Pal Singh (Revised), Eastern Book Company, Edition: 13th Edition, 2017, Reprint 2019.
2. "Ethics in Engineering" by Martin, W. Mike., Schinzinger, Roland., McGraw-Hill Education; 4th edition (February 6, 2004).

E-Books and online course materials:

1. https://www.smartzworld.com/notes/constitution-of-india-and-professional-ethics-notes-vtu-cip-pdf/
2. https://legalstudymaterial.com/constitution-of-india/

Course Assessment and Evaluation:

Component	Type of assessment	Max. Marks	Total	50 % Weightage	Total
CIE – Theory	Quiz	10	100	5	50
	AAT	10		5	
	Test 1	40		20	
	Test 2	40		20	
	Test 3	40		20	
SEE	End Exam	100		50	

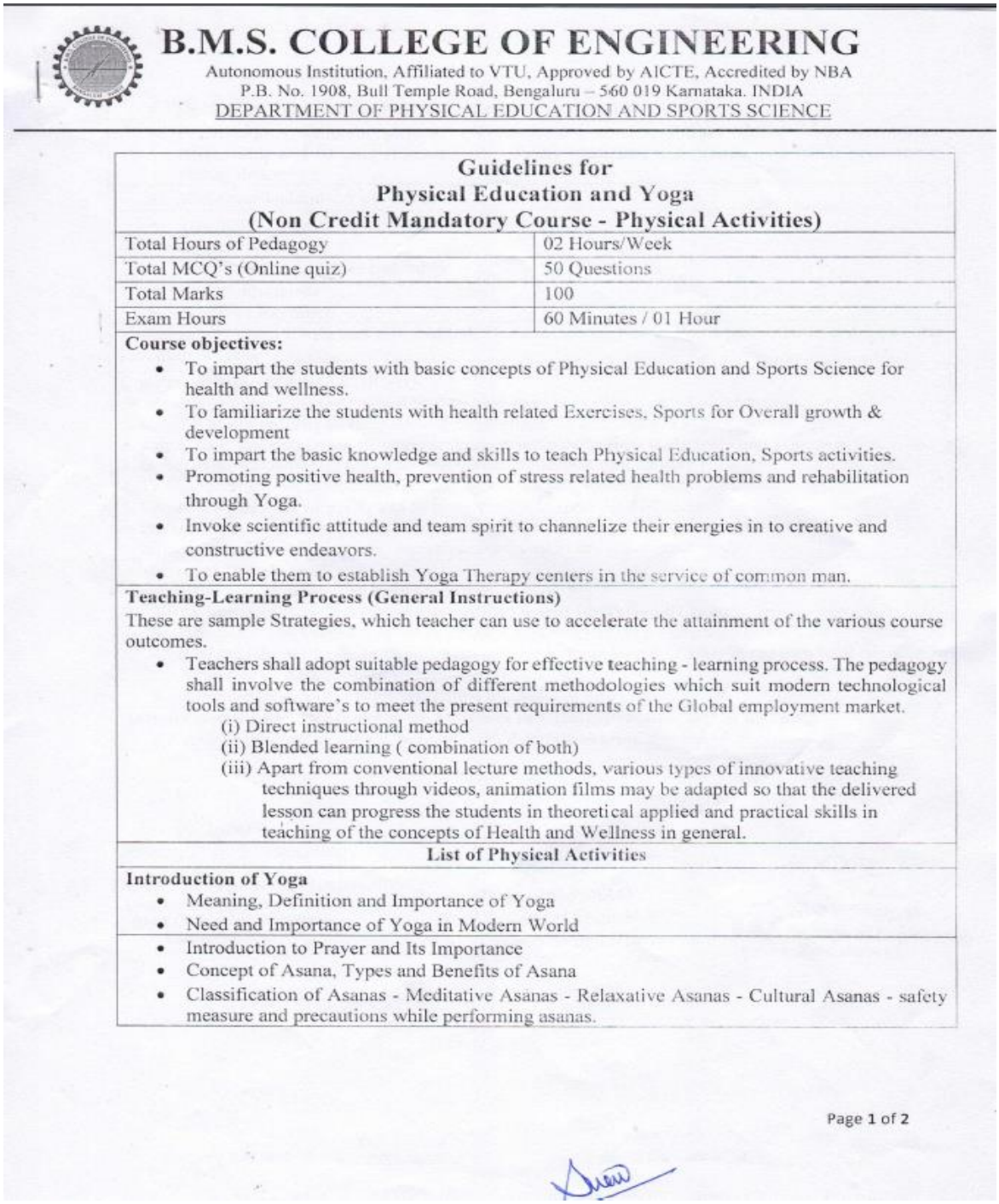
Two best scores out of the three tests will be considered for CIE.

CIE methods/question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

SEE Exam Question paper format

SEE	Online Examination		
Pattern	50 Multiple Choice Questions	Total Marks	50X2=100

Semester	III		
Course Title	Physical Activity	**Course Code**	22MD3NCPYA
Credits	NCMC	**L-T-P**	-----



B.M.S. COLLEGE OF ENGINEERING

Autonomous Institution, Affiliated to VTU, Approved by AICTE, Accredited by NBA
P.B. No. 1908, Bull Temple Road, Bengaluru – 560 019 Karnataka. INDIA
DEPARTMENT OF PHYSICAL EDUCATION AND SPORTS SCIENCE

Guidelines for
Physical Education and Yoga
(Non Credit Mandatory Course - Physical Activities)

Total Hours of Pedagogy	02 Hours/Week
Total MCQ's (Online quiz)	50 Questions
Total Marks	100
Exam Hours	60 Minutes / 01 Hour

Course objectives:

- To impart the students with basic concepts of Physical Education and Sports Science for health and wellness.
- To familiarize the students with health related Exercises, Sports for Overall growth & development
- To impart the basic knowledge and skills to teach Physical Education, Sports activities.
- Promoting positive health, prevention of stress related health problems and rehabilitation through Yoga.
- Invoke scientific attitude and team spirit to channelize their energies in to creative and constructive endeavors.
- To enable them to establish Yoga Therapy centers in the service of common man.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

- Teachers shall adopt suitable pedagogy for effective teaching - learning process. The pedagogy shall involve the combination of different methodologies which suit modern technological tools and software's to meet the present requirements of the Global employment market.
  - (i) Direct instructional method
  - (ii) Blended learning (combination of both)
  - (iii) Apart from conventional lecture methods, various types of innovative teaching techniques through videos, animation films may be adapted so that the delivered lesson can progress the students in theoretical applied and practical skills in teaching of the concepts of Health and Wellness in general.

List of Physical Activities

Introduction of Yoga

- Meaning, Definition and Importance of Yoga
- Need and Importance of Yoga in Modern World

- Introduction to Prayer and Its Importance
- Concept of Asana, Types and Benefits of Asana
- Classification of Asanas - Meditative Asanas - Relaxative Asanas - Cultural Asanas - safety measure and precautions while performing asanas.

Page 1 of 2

• Concept of Pranayama, types and benefits of Pranayama • Pranayama – different phases in Pranayama practices: Puraka (Inhalation), Kumbhaka (Retention) and Recaka (Exhalation), - safety measures and precautions while performing pranayama.
• Meditation techniques and its benefits
• Practicing methods and benefits of Kriyas.
Physical Exercise • Health Related Fitness Exercises • Ladder Exercises • Aerobics Exercises
Teaching Learning process: Chalk and talk method, Demonstration, Power Point presentation and YouTube videos.
Course outcome (Course Skill Set) At the end of the course the student will be able to 1. Identify asana specific to their desired health benefits and create a yoga practice 2. Apply their understanding of yogic text and principles to their daily lives and yoga practice 3. Understand fundamental concepts of physical education and sports. 4. To produce learners with fundamental theory, training methods and sports pedagogy. 5. Create a wider base of personnel to pursue various sport related careers. 6. Demonstrate an understanding of anatomy and physiology as it applies to the intentional integration of breath, postures, and movement within the practice of yoga
Assessment Details (SEE) 1. SEE will be conducted through online 2. Online quizzes will be conducted for 100 marks **(duration 01 hour)** 3. The pattern of question paper is MCQ's, 50 question each carries 2 marks 4. The student has to score a minimum of 60% (60 marks out of 100) in the sum total of the Semester End Examination. 5. Attendance is compulsory for offline classes.
Activity based Learning (suggested Activities in Class)/ Practical Based learning • Asanas practice session, Contents related activities (Activity-based discussions)

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Dr. M. Shivarama Reddy
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Vice Principal
B.M.S. College of Engineering
Bangalore-19.

IV

Semester Syllabus

(Common to AS/ME /EEE/ECE/ET/MD/CIVIL/EIE)

Course Title	COMPLEX ANALYSIS, PROBABILITY AND STATISTICAL METHODS	Course Code	22MA4BSCPS
Credits	**03**	**L – T – P**	**2-1-0**
Contact Hours	**40**		

COURSE OBJECTIVES: The goal of the course is to:

- Appreciate the importance of Complex Analysis, Special Functions, Probability and Statistics in Engineering.
- Acquire the knowledge of Complex Analysis, Special Functions, Probability and Statistics applied in their core domain.
- Improve their Mathematical thinking and acquire skills required for sustained lifelong learning.

TEACHING-LEARNING PROCESS (General Instructions):

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

4. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
5. State the need for Mathematics with Engineering Studies and Provide real-life examples.
6. Encourage the students for group learning to improve their creative and analytical skill.

UNIT-1

COMPLEX ANALYSIS: **[08 hours]**

Review of a function of a complex variable, limits, continuity and differentiability.

Analytic functions: Cauchy-Riemann equations in Cartesian and polar forms and consequences. Construction of analytic functions by Milne-Thomson method, Problems.

Conformal mapping: $w = z^2$ and $w = z + \frac{k^2}{z}\ (z \neq 0)$.

Complex integration: Line integral of a complex function, Cauchy's theorem and Cauchy's integral formula and problems.

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and Board, Problem based learning / Presentation

UNIT-2

SPECIAL FUNCTIONS: [08 hours]

Introduction, Ordinary and Singular Points, Series solution of Bessel's differential equation leading to $J_n(x)$, Bessel's function of the first kind, Properties, generating function for $J_n(x)$. Series solution of Legendre's differential equation leading to $P_n(x)$, generating function for $P_n(x)$. Legendre polynomials, Rodrigue's formula (without proof) - Problems.

Teaching-Learning Process	Chalk and Board, Problem based learning / Presentation

UNIT-3

STATISTICAL METHODS: [08 hours]

Correlation and regression - Karl Pearson's coefficient of correlation and rank correlation, problems. Regression analysis: lines of regression, angle between two regression lines - problems.

Curve Fitting: Fitting the straight line, parabola and geometric curve ($y = a x^b$) by the method of least squares.

Teaching-Learning Process	Chalk and Board, Problem based learning / Presentation

UNIT-4

PROBABILITY DISTRIBUTIONS: [08 hours]

Review of basic probability theory. Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation, mean and variance. Poisson and normal distributions- problems (derivations for mean and standard deviation for Poisson distribution only)-Illustrative examples.

Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation, covariance and correlation.

Teaching-Learning Process	Chalk and Board, Problem based learning / Presentation

UNIT-5

STATISTICAL INFERENCE: [08 hours]

Sampling Theory: Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test of hypothesis for means (single mean and difference between two means), student's t-distribution (single mean and difference between two means), Chi-square distribution as a test of goodness of fit.

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and Board, Problem based learning / Presentation

Course outcomes (Course Skills Set)

After successfully completing the course, the student will be able to understand the topics:

Course Code	CO	COURSE OUTCOME (CO)	PO	Strength
22MA4BSCPS	CO 1	Apply the concepts of complex variables, special functions, probability and statistics to solve engineering problems.	1	3
	CO 2	Analyze the engineering data/problems using special functions, complex variables and statistical methods.	1	1
	CO 3	Demonstrate the importance of complex variables, special functions and statistical methods using programing tools.	5, 9, 10	1

Assessment Details (both CIE and SEE)

Component	Type of assessment	Max. Marks	Total	50 % Weightage	Total
CIE – Theory	Quiz	10	100	5	50
	AAT	10		5	
	Test 1	40		20	
	Test 2	40		20	
	Test 3	40		20	
SEE	End Exam	100		50	

Two best scores out of the three tests will be considered for CIE.

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

SEMESTER END EXAMINATION:

- Each unit consists of one full question.
- Five full questions to be answered.
- To set one question each from Units 2, 3, 4 and two questions each from Unit 1 and Unit 5.

SUGGESTED LEARNING RESOURCES:

TEXT BOOKS:

1. Higher Engineering Mathematics, B. S. Grewal Khanna Publishers 44th Edition, 2017.

2. Advanced Engineering Mathematics, E. Kreyszig: John Wiley & Sons, 10th Ed. (Reprint), 2016.

REFERENCE BOOKS:

1. Advanced Engineering Mathematics C. Ray Wylie, Louis C.Barrett McGraw-Hill 6th Edition 1995.
2. Higher Engineering Mathematics B. V. Ramana McGraw-Hill 11th Edition,2010.
3. A Text-Book of Engineering Mathematics N. P. Bali and Manish Goyal Laxmi Publications 2014.
4. Advanced Engineering Mathematics Chandrika Prasad and Reena Garg Khanna Publishing, 2018.

WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/
4. http://www.bookstreet.in.
5. VTU EDUSAT PROGRAMME – 20
6. VTU e-Shikshana Program

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emester	**IV**			
Course Title	**PHYSIOLOGICAL CONTROL SYSTEM**	**Course Code**	**22MD4PCPCS**	
Credits	**3**	**L-T-P**	**2:1:0**	**Total Hrs: 25**
Pre Requisites: Calculus and differential equations, Advanced calculus and numerical methods, Engineering Mathematics and Linear Circuit Analysis				
Course Outcomes				
CO1	Apply the knowledge of engineering and mathematics to develop mathematical models for classical and physiological control systems			
CO2	Identify and analyze the time responses of conventional and physiological control systems.			
CO3	Design and Investigate the stability of control systems using both time response and frequency response analysis.			
CO4	Analyze the complex problems in physiological control systems through parametric and nonparametric identification methods			
CO5	Implement the control theory concepts using modern tools (MATLAB/OPEN-SOURCE TOOL/LAB VIEW) working in a team for the chosen control system problems and write report of the same.			
CO6	Function effectively to communicate as an individual to present the outcome of the implemented work in a team.			
UNIT 1				
Introduction: Examples of Control Systems, open loop vs. Closed loop Systems, Mathematical Modelling of Linear Systems: Transfer functions, Mechanical Systems Analogous Systems, Block diagram, Signal Flow graph. Difference between Engineering and Physiological Control Systems. **Case Study:** Block diagram representation of the muscle stretch reflex, contributions of the muscle stretch reflex, adaptive characteristics of the muscle stretch reflex. Linear model of respiratory mechanics, linear model of muscle mechanics, lumped and distributed parameter of an unmyelinated nerve fiber.				5Hrs

UNIT 2	
Time Response Analysis of the Control System: Step response of first order, second order systems, response specification, steady state error and error constants. **Case Study:** Steady State Characteristics of the Muscle Stretch Reflex Model components, Regulation of Cardiac Output, Regulation of Glucose and Insulin, Steady State Closed Loop Analysis of Cardiac Output Regulation, chemical regulation of ventilation, Response of Lung Mechanics Model.	5Hrs
UNIT 3	
Stability Analysis: Concept of stability, RH criterion, applications of RH criterion with limitations. Root locus technique: Introduction to root locus concepts, Construction rules, Analysis of stability by root locus plot. **Case Study:** Stability analysis of the pupillary reflex.	5Hrs
UNIT 4	
Identification of Physiological Control Systems: Basic problems in physiological system analysis, Nonparametric and parametric identification of methods: - list of various methods only. Identification of closed loop systems:- **Case Studies:** The starling Heart-Lung Preparation, Kao's cross circulation experiments, minimal model of blood glucose regulation, respiratory control system.	5Hrs
UNIT 5	
Frequency Response Analysis: Bode plots and Frequency domain specification. **Case studies :** Bode plots and frequency responses of the linearized lung mechanics, heart rate and arterial blood pressure, glucose-insulin regulation model in Type-2 diabetic**.**	5Hrs
Text Books:	
1 Engineering control systems - Norman S. Nise, John WILEY & Sons , fifth Edition.	

2	Physiological control system- Michael. C.K .Khoo.	
Reference Books:		
1	Modern control Engineering- Ogata, Prentice Hall	
2	Control Engineering by Nagrath & Gopal, New Age International Publishers	
Online courses:		
1	www.nptel.com/IITK	
2	http://nptel.ac.in/courses/108103007/1	
E-Books:		
1	http://www.electrical4u.com/control-system-closed-loop-open-loop-control-system/#practical-examples-of-open-loop-control-system	
2	http://www.facstaff.bucknell.edu/mastascu/eControlHTML/CourseIndex.html	

Semester	IV			
Course Title	**Diagnostic and Therauptic Instruments**	**Course Code**	**22MD4PCDTE**	
Credits	4	**L-T-P**	**3-0-1**	**Total Hrs: 40**
Pre Requisites: **Physiological systems and Bio signal Measurements.**				
Course Outcomes				
CO1	Apply the engineering fundamentals in designing, analysing and working of biomedical circuits and instruments			
CO2	Apply the reasoning for the health, safety, Environmental and ethical issues while Designing/working with Diagnostic and Therapeutic equipment			
CO3	Conduct experiments using modern equipments & tools.			
CO4	Use current techniques, modern tools and computing practice to improve Health care instruments through hospital visits			
CO5	Present and document the case study on usage of Diagnostic and Therapeutic equipments			
UNIT 1				

Bio-signals characteristics and Amplifiers – frequency and amplitude ranges, and charactestics of bio signals Need for bio-amplifier — single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Band pass filtering, isolation amplifiers – transformer and optical isolation — isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference. **Patient monitoring System concepts,** cardiac monitor, bedside patient monitoring system, central monitors, measurement of heart rate, measurement of pulse rate, blood pressure measurement, measurement of temperature, measurement of respiratory rate, catheterization laboratory instrumentation	8Hrs
UNIT 2	
Diagnostic Instruments: Oximeters: Oximetry, ear oximeter, pulse oximeter, skin reflectance oximeter and intravascular oximeter. Blood Flow Meters: Electromagnetic blood flow meters different types, Ultrasonic blood flow meters, NMR blood flow meters and Laser Doppler blood flow meters. **Blood Gas Analyzers**: Acid-base balance, blood pH measurement, measurement of blood pCO2, intra-arterial blood gas monitoring, complete blood gas analyzer. Audiometer and Hearing Aids: Mechanism of hearing, measurement of sound, basic audiometer, pure-tone audiometer, speech.	8Hrs
UNIT 3	
Cardiac assist devices: Cardiac pacemakers-Need, types and functional characteristics, AC Cardiac defibrillators, disadvantages, DC defibrillator, types- Instantaneous, Synchronized **Cardiac output measurements**: Indicator dilution method, Dye dilution method, Thermal dilution techniques, Measurement of continuous cardiac output derived from the aortic pressure waveform, Impedance technique. Pulmonary Function Analyser: Pulmonary function measurement, Spirometer, Pneumotachometer, Measurement of volume by Nitrogen washout technique	8Hrs
UNIT4	
Therauptic Equipment: Short wave diathermy, ultrasonic diathermy, Microwave diathermy, Electro surgery machine — Current waveforms, Tissue Responses, Electro surgical current level, Hazards and safety procedures. Effects of ionizing radiation, Radiation therapy – Cobalt Caesium therapy, linear accelerator, **Patient Safety:** Electric shock hazards, Leakage currents, safety codes and analyser. Ethical issues in the design of Biomedical Instruments.	8Hrs
UNIT5	
Hemodialysis and heart lung machine : Indication and principle of Hemodialysis, Dialysate, different types of Hemodialysis, monitoring systems, Need for heart lung machine, functioning of bubble, disc type and membrane type oxygenators, finger pump, roller pump, monitoring systems. **Respiratory aids** : Ventilator- Need, Types, Intermittent positive pressure, breathing apparatus operating sequence, electronic IPPB unit with monitoring for all respiratory parameters, Humidifier, Nebulizer, Aspirator.	8Hrs

Text Books		
1	R.S. Khandpur, Handbook of Biomedical Instrumentation, 3-e, McGraw Hill, 2014	
2	Joseph .J.Carr and John .M.Brown, "Introduction to Biomedical Equipment Technology," John Wiley&Sons Inc, New York-2002on protection principles.	
Reference Books:		
1	John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 2004.	
2	Leslie Cromwell, Fred. J. Weibel, Erich.A.Pferffer, "Biomedical Instrumentation and Measurements," Prentice Hall India, NewDelhi-2001.	
Online courses:		
1	Ma, Hongshen. 2.996 Biomedical Devices Design Laboratory, Fall 2007. (MIT OpenCourseWare: Massachusetts Institute of Technology), 2006	
2	http://ocw.mit.edu/courses/biological-engineering/20-010j-introduction-to-bioengineering-be-010j-spring-2006 (Accessed 26 Jul, 2014). License: Creative Commons BY-NC-SA.	
3	http://oyc.yale.edu/biomedical-engineering/beng-100	
4	Biomedical virtual laboratory link.http://vlab1.iitr.ac.in/	
E-Books:		
1	E-book 1http://www.ebook3000.com/Introduction-to-Biomedical-Instrumentation—The-Technology-of-Patient-Care_51854.html	
2	Barbara Christe, Introduction to Biomedical Instrumentation: The Technology of Patient Care, Cambridge University Press | 2009 | ISBN: 0521515122	
Lab Component:		
List of Experiments: – LIST OF EXPERIMENTS: 1. Measurement of EMG Signal using Bio-Pac –Acquisition System 2. Measurement of EEG Signal using Bio-Pac –Acquisition System 3. Design of Instrumentation Amplifiers 4. Design of Isolation Amplifiers 5. Surgical Diathermy 6. Study Experiment on Pacemakers 7. Study Experiment on Defibrillators 8. EEG signal Acquisition using Power lab 9. EEG signal Acquisition using ENO-BIO software 10. EEG signal measurement using Neuro- feedback and Bio-feedback 11. Multipara meter monitoring system for vital parameters		

Medical Electronics Engineering | 2021-25

(Common to ALL Electrical Cluster Braches)

Semester	IV			
Course Title	ARM Processor and Programming	**Course Code**	22ES4PCAPP	
Credits	4	**L-T-P**	**3-0-1**	Total Hrs: 40
Pre Requisites: Basic Electronics Engineering				
Course Outcomes: At the end of the course students will be able to,				
CO1	Understand the fundamental concepts of computer organization and ARM architecture			
CO2	Develop assembly language and embedded C programs by applying knowledge of the architectural features and instructions set of ARM processor			
CO3	Conduct experiments using suitable IDE with assembly and Embedded C programming.			
CO4	Propose a Healthcare solution, design the model using ARM processor and present it in a team			
CO5	Prepare the technical document on the proposed Healthcare solution with ARM			

UNIT 1	
Overview of computing systems: Basic structure of computers- function units of a computer, bus structure, performance of the processor, memory location and addresses, memory and I/O systems , basic processing unit, pipelining, computer peripherals	8Hrs
UNIT 2	
ARM Processor fundamentals -RISC and ARM Design philosophy, ARM core Dataflow model, programming model, processor states and operating modes, exceptions and interrupts, ARM pipeline, ARM instruction set, Assembler rules and Directives, load/store architecture, ARM-THUMB interworking, programming	8Hrs
UNIT 3	
Embedded C codes- overview of C compiler and optimization, Basic C data types, Local variable types, C looping and structures, Registrar allocation, function calls, pointer aliasing, Writing and optimizing assembly codes, mixing C and Assembly, programming, instruction scheduling	8Hrs
UNIT 4	
Subroutines and stacks-introduction, stack, subroutines, passing parameters to Subroutines, Exception and interrupt handling- Vector Table, Exception priorities, link register offsets, interrupts. Interrupt handling schemes	8Hrs
UNIT 5	
Application of ARM controller LPC 2148/ LPC1768 : Memory map, memory and I/O mapped peripherals- ADC, DAC and UART, firmware and boot loader, introduction to Embedded Operating System	8Hrs

Text Books

1	Computer Organization and Architecture, Carl Hamacher, Zvonko Vranesic, McGraw-Hill,2001	
2	ARM System Developer's Guide, Sloss, Symes, WrightMorgan Kaufmann Publishers, Elsevier,2005	
3	ARM Assembly Language- Fundamentals and Techniques, William	

	Hohl, CRC press, Taylor and Frncis,2009	
Reference Books:		
1	Computer Organisation & Architecture , William Stallings, PHI , 2010	
2	ARM System –on-Chip Architecture , Steve Furber, Seocnd Edition, Pearson, 2010	
Online courses: The link given cover all 5 Units		
1	https://onlinecourses.nptel.ac.in/noc20_cs15/	
2	https://www.udemy.com/course/embedded-system-programming-on-arm-cortex-m3m4/	
3	https://nptel.ac.in/courses/108102045	
E-Books:		
1	https://www.pdfdrive.com/arm-microprocessor-systems-cortex-m-architecture-programming-and-interfacing-e157100364.html	
2	https://www.pdfdrive.com/practical-microcontroller-engineering-with-arm-technology-e34433659.html	
Lab Component :		
List of Experiments: – Assembly, Embedded C Programming and Interfacing Experiments **1. Data Transfer** **2. Arithmetic and Logical operations** **3. Embedded C Programming** **4. GPIO Programming** **5. Interfacing Experiments**		

(Common to Med. Elns. and EIE)

Semester	IV			
Course Title	Linear Integrated Circuits	**Course Code**	22ES4PCLIC	
Credits	4	**L-T-P**	3-0-1	**Total Hrs**: 40
Pre-Requisites: Basic concepts of analog electronic circuits and their analysis.				
Course Outcomes: At the end of the course students will be able to				
CO1	Apply the knowledge of electronic engineering fundamentals to comprehend linear integrated circuit based systems.			
CO2	Analyze and interpret the effects of DC and AC limitations of Operational Amplifiers using the first principles of electronics.			
CO3	Design and develop analog sub-circuits for linear and non-linear applications in the areas of sourcing, signal - generation, conditioning, and communication.			

CO4	Conduct investigations by designing experiments and solutions for signal processing using digital-to-analog and analog-to-digital conversions.	
CO5	Experiment, document and present the test results of various applications of linear integrated circuits, and open-ended experiments, working both independently and in teams.	
UNIT 1		
Operational Amplifier Characteristics and Basic Applications: Introduction, Internal block diagram of OP-amp, DC and AC Characteristics – definitions, limitations and errors in practical circuits, Basic Closed loop configurations, Frequency Compensation. DC Applications: V to I, and I to V converters, Application in series voltage regulator, Example designs with LM723. Instrumentation Amplifiers (IA), IA Chips. AC Applications: Inverting and Non-inverting AC amplifiers, Precision half wave and full wave rectifiers, Sample and Hold circuits.		8Hrs
UNIT 2		
Comparators and Waveform Generators: Introduction, Comparator, Schmitt Trigger, Square wave generator using Astable and Monostable Multivibrators, Triangular waveform generator, Sinusoidal oscillators - RC phase-shift and Wien bridge oscillators.		8Hrs
UNIT 3		
Active Filters: Introduction, Passive versus Active Filters, Differentiator and Integrator Circuits, Active Filters: First and Second order Low pass and high pass filters, Realization of higher order filters, Notch filter for power line noise removal, All pass filter-phase shift lead and lag types.		8Hrs
UNIT 4		
Data Converters: Introduction, Digital-to-analog converters (DAC): Specifications, basic DAC techniques-weighed resistor DAC, R-2R ladder DAC, and Inverted Ladder DAC. Analog-to-digital Converters (ADC): Specifications, and Types of ADCs - Counter type, Successive Approximation, Single and Dual slope, Flash, and Sigma – delta. Applications of DACs and ADCs. Data Acquisition systems		8Hrs
UNIT 5		
Phase Locked Loops: Basic Principles, Analog and Digital Phase detectors, Voltage Controlled Oscillator, LPF. Applications of PLL in Frequency multiplication, division and translation.		8Hrs
Text Books		
1	D.Roy Choudhury and Shail B.Jain, Linear Integrated Circuits, 4e, New Age International Publishers, 2010	
2	S.Salivahanan & V.S.Kanchana Bhaaskaran, Linear Integrated Circuits, 2e, McGraw - Hill Publication	
Reference Books:		

1	Ramakanth A.Gayakwad, Op-Amps and Linear Integrated Circuits,4th ed, PHI	
2	James M. Fiore, Op Amps and Linear Integrated Circuits- Concepts and Applications, Cengae Learning, 2011	
Online courses:		
1	https://swayam.gov.in/nd1_noc19_ee39/preview – op amp practical applications: design, simulation and implementation by Dr. Hardik J. Pandya , IISc Bangalore	
2	https://www.udemy.com/course/operational-amplifiers-linear-integrated-circuits/	
3	http://www.pannam.com/blog/free-resources-to-learn-electrical-engineering/	
E-Books:		
1	https://web.mit.edu/6.101/www/reference/op_amps_everyone.pdf	
2	https://electronicsforu.com/resources/7-free-ebookstutorials-on-op-amp	
3	https://www.analog.com/en/education/education-library/tutorials/analog-electronics.html	
Lab Component:		
List of Experiments: – 1. Inverting and non-inverting amplifier, voltage follower 2. Instrumentation Amplifier 3. Precision half wave and full wave rectifier 4. Voltage Comparators and Schmitt Trigger 5. Square waveform generator using AMV 6. Triangular waveform Generator 7. RC- Phase shift and Wien bridge Oscillators 8. First and Second order low pass and high pass filter 9. Second Order Low pass filter 10. Data Acquisition using myDAQ		

Semester	IV		
Course Title	Seminar on Internship	**Course Code**	22MD4SRIN1
Credits	1	**L-T-P**	0-0-1

Guidelines for Summer Internship:

1. This First Internship is of 2-4 weeks duration with NGO / Social Activity implemented during semester break after 2nd or 3rd semester and evaluated through seminar and report in the 4th semester.
2. All the students admitted shall have to undergo a mandatory summer internship of 4-6 weeks during the intervening vacation of II and III semesters.
3. Students can do Summer Internship based on social activity either with NGO or organization working to solve societal issues.
4. A Viva-voce examination (Presentation followed by question-answer session) shall be conducted during IV semester.
5. The evaluation of this course will be based on Rubrics designed. The internship shall be considered as a head of passing and shall be considered for the award of degree.
6. 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.
7. The faculty coordinator or mentor will to monitor the students' internship progress and interact to guide them for the successful completion of the internship.
8. The details of the internship to be recorded by proctor in the proctor diary.

Semester	IV		
Course Code	22MA4HSUHV	Course Name	Universal Human Values
Credits	01	L-T-P	0-1-0
Total Number of hours		15	

Course Objectives:

To develop a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.

UNIT – 1

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment 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 fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

UNIT – 2

Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
2. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
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 Health; correct appraisal of Physical needs, meaning of Prosperity in detail
6. Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

UNIT – 3

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

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
2. Understanding the meaning of Trust; Difference between intention and competence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives

UNIT – 4

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

1. Understanding the harmony in the Nature
2. Holistic perception of harmony at all levels of existence.

UNIT – 5

Implications of the above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

At the end of the course, the student will have the ability to

CO1	Conduct self-exploration and distinguish between values and skills, happiness and accumulation of physical facilities, the self and the body, Intension and Competence of an individual
CO2	Analyze the value of harmonious relationship based on trust and respect in personal and professional life
CO3	Examine the role of a human being in ensuring harmony in society and nature
CO4	Apply the understanding of ethics in life and profession

Assessment Details (both CIE and SEE)

Component	Type of assessment	Max. Marks	Total
CIE – Theory	AAT 1	10	100
	Test 1	40	
SEE	End Exam	50	

Only one CIE shall be conducted after CIE2 and before CIE 3. SEE paper shall be set for 50 Questions, each of the 01 marks. The pattern of the Question paper is MCQ (Multiple Choice Questions). The time allotted 01 hour.

TEXT BOOKS:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

REFERENCE MATERIAL:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)

Semester	IV			
Course Title	Object Oriented Programming	**Course Code**	22MD4AEOOP	
Credits	1	**L-T-P**	0:0:1	Total Hrs: 15
Pre Requisites: Basic C Programming or Any programming language				
Course Outcomes: A the end of the course students will be able to				
CO1	Formulate, design, implement, analyse the OOPs concepts			
CO2	Demonstrate the concepts of OOPs as application implemented using modern tools			
CO3	Document and present the concepts of OOPs as application implemented in groups or individual.			
Syllabus				
OOPs Paradigm-Programming language, Object-Oriented Programming, Object-Oriented Languages, Basic concept of oops, Structure, Functions, classes, Arrays, Inheritance. Programs related to the oops concepts. Implementation of oops concepts practically using the modern tools and develop an application for the case study conducted or modern day problems. Experiments based on Structures, Arrays, Classes, Inheritance and other OOPs concepts. Students need to execute an open ended projects based on the OOPs concepts and the same thing is considered for the evaluation purpose				
Text Book:				
1	Object Oriented Programming with C++, E Balaguruswamy, Third edition, TMH 2006			
Reference book:				
1	Object oriented programming in TURBO C++, Robert Lafore, Galgotia Publications.2002			
E-Books:				
1	http://www.ddegjust.ac.in/studymaterial/mca-3/ms-17.pdf			
2	https://bookstore.github.io/cse/secondyear/Balaguruswamy%20Object%20Oriented%20Programming%20With%20C++%20Fourth%20Edition.pdf			
Online courses:				
1	https://www.udemy.com/course/object-oriented-programming-in-c-m/			
2	https://www.udemy.com/course/c-programming-oops-concepts/			

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ

ವಿಷಯ ಸಂಕೇತ (Course Code)	22MA4HSSAK	ನಿರಂತರ ಆಂತರಿಕ ಮೌಲ್ಯ ಮಾಪನ ಅಂಕಗಳು.	50
ಒಂದು ವಾರಕ್ಕೆ ಬೋಧನಾ ಅವಧಿ (Teaching Hours / week (L:T:P:S)	1-0-0	ಸೆಮಿಸ್ಟರ್ ಅಂತ್ಯದ ಪರೀಕ್ಷೆಯ ಅಂಕಗಳು	50
ಒಟ್ಟು ಬೋಧನಾ ಅವಧಿ Total Hours of Pedagogy	15 ಗಂಟೆಗಳು	ಒಟ್ಟು ಅಂಕಗಳು	100
ಕ್ರೆಡಿಟ್ಸ್ (Credits)	01		

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಪಠ್ಯದ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು :

1. ವೃತ್ತಿಪರ ಪದವಿ ವಿದ್ಯಾರ್ಥಿಗಳಾಗಿರುವುದರಿಂದ ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡದ ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.
2. ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಪ್ರಧಾನ ಭಾಗವಾದ ಆಧುನಿಕ ಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳನ್ನು ಸಾಂಕೇತಿಕವಾಗಿ ಪರಿಚಯಿಸಿ ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಸಾಹಿತ್ಯ ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಅರಿವು ಹಾಗೂ ಆಸಕ್ತಿಯನ್ನು ಮೂಡಿಸುವುದು.
3. ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯವನ್ನು ಹಾಗೂ ಅವರುಗಳ ಸಾದಿಸಿದ ವಿಷಯಗಳನ್ನು ಪರಿಚಯಿಸುವುದು. ಕನ್ನಡ ಶಬ್ದ ಸಂಪತ್ತಿನ ಪರಿಚಯ.

ಭೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವ್ಯವಸ್ಥೆ (Teaching – Learning Process – General Instructions):

These are sample Strategies; which teacher can use to accelerate the attainment of the course outcomes.

1. ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡವನ್ನು ಬೋಧಿಸಲು ತರಗತಿಯಲ್ಲಿ ಶಿಕ್ಷಕರು ಪ್ರಸ್ತುತ ಪುಸ್ತಕ ಆಧರಿಸಿ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನವನ್ನು ಅನುಸರಿಸುವುದು. ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ಗಳನ್ನು ತಯಾರಿಸಲು ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಪ್ರೇರೇಪಿಸುವುದು ಮತ್ತು ತರಗತಿಯಲ್ಲಿ ಅವುಗಳನ್ನು ಚರ್ಚಿಸಲು ಅವಕಾಶ ಮಾಡಿಕೊಡುವುದು.
2. ಇವತ್ತಿನ ತಂತ್ರಜ್ಞಾನದ ಅನುಕೂಲಗಳನ್ನು ಬಳಸಿಕೊಳ್ಳುವುದು - ಅಂದರೆ ಕವಿ - ಕಾವ್ಯ ಪರಿಚಯದಲ್ಲಿ ಕವಿಗಳ ಚಿತ್ರಣ ಮತ್ತು ಲೇಖನಗಳು ಮತ್ತು ಕಥೆ ಕಾವ್ಯಗಳ ಮೂಲ ಅಂಶಗಳಿಗೆ ಸಂಬಂದಪಟ್ಟ ಧ್ವನಿ ಚಿತ್ರಗಳು, ಸಂಭಾಷಣೆಗಳು. ಈಗಾಗಲೇ ಇತರ ವಿಮರ್ಶಕರು ಬರೆದಿರುವ ವಿಮರ್ಶನಾತ್ಮಕ ವಿಷಯಗಳನ್ನು ಟಿಪಿಟಿ, ಡಿಜಿಟಲ್ ಮಾಧ್ಯಮಗಳ ಮುಕಾಂತರ ವಿಶ್ಲೇಷಿಸುವುದು.
3. ನವೀನ ಮಾದರಿಯ ಸಾಹಿತ್ಯ ಬೋಧನೆಗೆ ಸಂಬಂಧಪಟ್ಟ ವಿಧಾನಗಳನ್ನು ಶಿಕ್ಷಕರು ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಅನುಕೂಲವಾಗುವ ರೀತಿಯಲ್ಲಿ ಅಳವಡಿಸುವುದು.

ಘಟಕ - 1	**3 Hours**

ಲೇಖನಗಳು:

1. ಕರ್ನಾಟಕದ ಏಕೀಕರಣ: ಒಂದು ಅಪೂರ್ವ ಚರಿತ್ರೆ - ಜಿ. ವೆಂಕಟಸುಬ್ಬಯ್ಯ.
2. ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ - ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ ಮತ್ತು ಪ್ರೊ. ವಿ. ಕೇಶವಮೂರ್ತಿ.

ಭೋದನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪ್ಟ್ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವೀಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಕಾಂತರ ಚರ್ಚಿಸುವುದು.

ಘಟಕ - 2	4 Hours
ಆಧುನಿಕ ಪೂರ್ವದ ಕಾವ್ಯ ಭಾಗ: 1. ವಚನಗಳು: ಬಸವಣ್ಣ, ಅಕ್ಕ ಮಹಾದೇವಿ, ಅಲ್ಲಮಪ್ರಭು, ಜೇಡರದಾಸಿಮಯ್ಯ , ಆಯ್ದಕ್ಕಿ ಲಕ್ಕಮ್ಮ. 2. ಕೀರ್ತನೆಗಳು: ಅದರಿಂದೇನು ಫಲ ಇದರಿಂದೇನು ಫಲ - ಪುರಂದರದಾಸರು ತಲ್ಲಣಿಸದಿರು ಕಂಡ್ಯ ತಾಳು ಮನವೇ - ಕನಕದಾಸರು	
ಭೋದನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪ್ಟ್ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವೀಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಕಾಂತರ ಚರ್ಚಿಸುವುದು .
ಘಟಕ - 3	**3 Hours**
ಆಧುನಿಕ ಕಾವ್ಯ ಭಾಗ: 1. ಕುರುಡು ಕಾಂಚಾಣ : ದಾ. ರಾ. ಬೇಂದ್ರೆ . 2. ಹೊಸಬಾಳಿನ ಗೀತೆ : ಕುವೆಂಪು	
ಭೋದನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪ್ಟ್ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವೀಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಕಾಂತರ ಚರ್ಚಿಸುವುದು .
ಘಟಕ - 4	**3 Hours**
ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯ, ಕಥೆ ಮತ್ತು ಪ್ರವಾಸ ಕಥನ: ಡಾ. ಸರ್. ಎಂ. ವಿಶ್ವೇಶ್ವರಯ್ಯ: ವ್ಯಕ್ತಿ ಮತ್ತು ಐತಿಹ್ಯ - ಎ ಎನ್ ಮೂರ್ತಿರಾವ್ ಮೆಗಾನೆ ಎಂಬ ಗಿರಿಜನ ಪರ್ವತ: ಹಿ. ಚಿ. ಬೋರಲಿಂಗಯ್ಯ	
ಭೋದನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪ್ಟ್ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವೀಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಕಾಂತರ ಚರ್ಚಿಸುವುದು.
ಘಟಕ - 5	**2 Hours**
ವಿಜ್ಞಾನ ಮತ್ತು ತಂತ್ರಜ್ಞಾನ: ಕನ್ನಡ - ಕಂಪ್ಯೂಟರ್ ಶಬ್ದಕೋಶ	
ಭೋದನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪ್ಟ್ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವೀಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಕಾಂತರ ಚರ್ಚಿಸುವುದು.

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಪರಿಣಾಮಗಳು (course Outcomes):
Course outcomes (Course Skills Set)

After successfully completing the course, the student will be able to understand the topics:

Course Code	CO	COURSE OUTCOME (CO)	PO
22HS3ICSAK 22HS44CSAK	CO 1	ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡ ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯವಾಗುತ್ತದೆ.	PO10
	CO 2	ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಆಧುನಿಕ ಪೂರಾ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳು ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಆಸಕ್ತಿ ಮೂಡುತ್ತದೆ.	PO10
	CO 3	ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯ, ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ, ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗು ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.	PO9

Assessment Details (both CIE and SEE)

Component	Type of assessment	Max. Marks	Total
CIE – Theory	AAT 1	10	100
	Test 1	40	
SEE	End Exam	50	

Only one CIE shall be conducted after CIE2 and before CIE 3. SEE paper shall be set for 50 Questions, each of the 01 marks. The pattern of the Question paper is MCQ (Multiple Choice Questions). The time allotted 01 hour.

ಪಠ್ಯ ಪುಸ್ತಕ:

ಡಾ. ಹಿ. ಚಿ. ಬೋರಲಿಂಗಯ್ಯ ಮತ್ತು ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ, ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

ಬಳಕೆ ಕನ್ನಡ			
ವಿಷಯ ಸಂಕೇತ (Course Code)	22MA4HSBAK	ನಿರಂತರ ಆಂತರಿಕ ಮೌಲ್ಯ ಮಾಪನ ಅಂಕಗಳು.	50
ಒಂದು ವಾರಕ್ಕೆ ಬೋಧನಾ ಅವಧಿ (Teaching Hours / week (L:T:P:S)	1-0-0	ಸೆಮಿಸ್ಟರ್ ಅಂತ್ಯದ ಪರೀಕ್ಷೆಯ ಅಂಕಗಳು	50
ಒಟ್ಟು ಬೋಧನಾ ಅವಧಿ Total Hours of Pedagogy	15 ಗಂಟೆಗಳು	ಒಟ್ಟು ಅಂಕಗಳು	100
ಕ್ರೆಡಿಟ್ಸ್ (Credits)	01		

ಬಳಕೆ ಕನ್ನಡ ಪಠ್ಯದ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು:

- To Create the awareness regarding the necessity of learning local language for comfortable and healthy life.
- To enable learners to Listen and understand the Kannada language properly.
- To speak, read and write Kannada language as per requirement and train the learners for correct and polite conservation.

ಭೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವ್ಯವಸ್ಥೆ (Teaching – Learning Process – General Instructions):

These are sample Strategies; which teacher can use to accelerate the attainment of the course outcomes.

4. ಬಳಕೆ ಕನ್ನಡವನ್ನು ತರಗತಿಯಲ್ಲಿ ಶಿಕ್ಷಕರು ಬೋಧಿಸಲು ವಿಟಿಯು ಸೂಚಿಸಿರುವ ಪಠ್ಯಪುಸ್ತಕವನ್ನು ಉಪಯೋಗಿಸಬೇಕು.
5. ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ಸ್‌ಗಳನ್ನು ತಯಾರಿಸಲು ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಉತ್ತೇಜಿಸುವುದು ಮತ್ತು ತರಗತಿಯಲ್ಲಿ ಅವುಗಳನ್ನು ಚರ್ಚಿಸಲು ಅವಕಾಶ ಮಾಡಿ ಕೊಡುವುದು.
6. ಪ್ರತಿ ವಿದ್ಯಾರ್ಥಿ ಪುಸ್ತಕವನ್ನು ತರಗತಿಯಲ್ಲಿ ಬಳಸುವಂತೆ ನೋಡಿಕೊಳ್ಳುವುದು ಮತ್ತು ಪ್ರತಿ ಪಾಠ ಮತ್ತು ಪ್ರವಚನಗಳ ಮೂಲ ಅಂಶಗಳಿಗೆ ಸಂಬಂಧ ಪಟ್ಟ ಪೂರಕ ಚಟುವಟಿಕೆಗಳಿಗೆ ತೊಡಗಿಸತಕ್ಕದ್ದು.
7. ಡಿಜಿಟಲ್ ತಂತ್ರಜ್ಞಾನದ ಮುಖಾಂತರ ಇತ್ತೀಚಿಗೆ ಡಿಜಿಟಲೀಕರಣ ಗೊಂಡಿರುವ ಭಾಷೆ ಕಲಿಕೆಯ ವಿಧಾನಗಳನ್ನು ಪಿಪಿಟಿ ದೃಶ್ಯ ಮಾಧ್ಯಮದ ಮುಖಾಂತರ ಚರ್ಚಿಸಲು ಕ್ರಮ ಕೈಗೊಳ್ಳುವುದು . ಇದರಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ತರಗತಿಯಲ್ಲಿ ಹೆಚ್ಚು ಏಕಾಗ್ರತೆಯಿಂದ ಪಾಠ ಕೇಳಲು ಮತ್ತು ಅಧ್ಯಯನದಲ್ಲಿ ತೊಡಗಲು ಅನುಕೂಲವಾಗುತ್ತದೆ.
8. ಭಾಷಾಕಲಿಕೆಯ ಪ್ರಯೋಗಾಲಯದ ಮುಖಾಂತರ ಬಹುಬೇಗ ಕನ್ನಡ ಭಾಷೆಯನ್ನು ಕಲಿಯಲು ಅನುಕೂಲವಾಗುವಂತೆ ಕಾರ್ಯ ಚಟುವಟಿಕೆಗಳನ್ನು ಮತ್ತು ಕ್ರಿಯಾ ಯೋಜನೆಗಳನ್ನು ರೂಪಿಸುವುದು.

UNIT – 1	2 Hours
1. Introduction, Necessity of learning a local language. Methods to learn the Kannada language. 2. Easy learning of a Kannada Language: A few tips. Hints for correct and polite conservation, Listening and Speaking Activities 3. Key to Transcription. 4. ವ್ಯಯಕ್ತಿಕ, ಸ್ವಾಮ್ಯ ಸೂಚಕ / ಸಂಬಂಧಿತ ಸಾರ್ವನಾಮಗಳು ಮತ್ತು ಪ್ರಶ್ನಾರ್ಥಕ ಪದಗಳು - **Personal Pronouns, Possessive Forms, Interrogative words**	
ಭೋದನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವೀಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಕಾಂತರ ಚರ್ಚಿಸುವುದು.
UNIT – 2	**3 Hours**
3. ಗುಣ, ಪರಿಮಾಣ ಮತ್ತು ವರ್ಣ ಬಣ್ಣ ವಿಶೇಷಣಗಳು, ಸಂಖ್ಯಾವಾಚಕಗಳು Qualitative, quantitative and colour adjectives, numerals. 4. ಕಾರಕ ರೂಪಗಳು ಮತ್ತು ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು - ಸಪ್ತಮಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು - (ಅ, ಅದು, ಅವು, ಅಲ್ಲಿ) predictive forms, locative case.	
ಭೋದನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವೀಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಕಾಂತರ ಚರ್ಚಿಸುವುದು.
UNIT – 3	**3 Hours**
3. ಚತುರ್ಥಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯದ ಬಳಕೆ ಮತ್ತು ಸಂಖ್ಯಾವಾಚಕಗಳು – Dative cases, and numerals. 4. ಸಂಖ್ಯಾವಾಚಕಗಳು ಮತ್ತು ಬಹುವಚನ ನಾಮರೂಪಗಳು – Ordinal numerals and Plural markers.	
ಭೋದನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವೀಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಕಾಂತರ ಚರ್ಚಿಸುವುದು.
UNIT – 4	**3 Hours**
1. ಅಪ್ಪಣೆ / ಒಪ್ಪಿಗೆ, ನಿರ್ದೇಶನ, ಪ್ರೋತ್ಸಾಹ ಮತ್ತು ಒತ್ತಾಯ ಅರ್ಥರೂಪ ಪದಗಳು ಮತ್ತು ವಾಕ್ಯಗಳು. Permission, Commands, encouraging and Urging words (Imperative words and sentences) 2. "ಇರು ಮತ್ತು ಇರಲ್ಲ" ಸಹಾಯಕ ಕ್ರಿಯಾಪದಗಳು, ಸಂಭಾವ್ಯ ಸೂಚಕ ಮತ್ತು ನಿಷೇಧಾರ್ಥಕ ಕ್ರಿಯಾ ಪದಗಳು. – Helping verbs “iru and iralla”, corresponding Future and negation verbs.	

ಭೋದನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವೀಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಕಾಂತರ ಚರ್ಚಿಸುವುದು.

UNIT – 5	**4 Hours**
1. ಕರ್ನಾಟಕ ರಾಜ್ಯ ಮತ್ತು ರಾಜ್ಯದ ಬಗ್ಗೆ ಕುರಿತಾದ ಇತರ ಮಾಹಿತಿಗಳು. Karnataka State and General Information about the State. 2. ಕನ್ನಡ ಭಾಷೆ ಮತ್ತು ಸಾಹಿತ್ಯ. Kannada Language and History. 3. Kannada Language Script Part – 1	
ಭೋದನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವೀಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಕಾಂತರ ಚರ್ಚಿಸುವುದು.

ಬಳಕೆ ಕನ್ನಡ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಅನುಕೂಲಗಳು ಮತ್ತು ಫಲಿತಾಂಶಗಳು:

Course outcomes (Course Skills Set)

After successfully completing the course, the student will be able to understand the topics:

Course Code	CO	COURSE OUTCOME (CO)	PO	Strength
22HS3ICBAK 22HS44CBAK	**CO 1**	To create an awareness regarding the necessity of learning local language for a comfortable living and to know more about Kannada culture and literature.	PO10	3
	CO 2	To develop proper speaking, reading and writing skills in Kannada.	PO10	3
	CO 3	To engage as a member of a team and enhance the skill in group communication and presentation.	PO9	1

Assessment Details (both CIE and SEE)

Component	Type of assessment	Max. Marks	Total
CIE – Theory	AAT 1	10	100
	Test 1	40	
SEE	End Exam	50	

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Only one CIE shall be conducted after CIE2 and before CIE 3. SEE paper shall be set for 50 Questions, each of the 01 marks. The pattern of the Question paper is MCQ (Multiple Choice Questions). The time allotted 01 hour.

ಪಠ್ಯ ಪುಸ್ತಕ:

ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ, ಬಳಕೆ ಕನ್ನಡ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

Semester	IV		
Course Title	**Cultural Activity**	**Course Code**	22MD4NCCLA
Credits	NCMC	**L-T-P**	---------

B.M.S. College of Engineering, Bangalore
Instructions and Evaluation Criterion for Cultural Activity
(Non-Credit Course) AY 2022-23

The meaning of culture is to be a dynamic, challenging and independent force based on freedom of expression that everyone is to be able to participate in cultural life, and that creativity, diversity and artistic quality are to be integral parts of society's development.

Cultural activity gives young people the chance to develop important life skills such as creativity, confidence, self-discipline, effective communication and the ability to work in teams.

List of cultural activities:

- **Dance – any Indian Dance form – Individual/Group**
- **Drawing/Painting**
- **Music – Any Instruments**
- **Singing – Classical, Folk and Light music**
- **Photography - Nature**
- **Short movie making – Minimum 1 minute**
- **Making pottery – Clay model**
- **Wood/Vegetable carving**
- **Drama**
- **Mono acting**
- **Any other work related to Arts**

Action plan for the assessment of the course:

1. Those students, who have already participated in any cultural activities during **this Academic Year/semester**, can produce a copy of their certificate for assessment.
2. Student who does not have any kind of certificate mentioned above, has to make presentation/performance evaluated by team framed by the HOD of the respective department. The department committee consists of Chairperson, Member-Convenor & other members (Preferably from college cultural committee).
3. Every student needs to submit a report 1 to 5 pages regarding extra cultural activity with
   - Learnings outcomes out of activity
   - Challenges faced and how he has been able to overcome?
   - Plan regarding usefulness of the task/activity for remaining part of life
   - Details of Assessment/Evaluation details at the department (certificates if any need to be enclosed)
4. Activities to be considered for evaluation
   - **Dance – any Indian Dance form** – Individual/Group to perform for a theme of duration 5 minutes to 10 minutes.
   - **Drawing/Painting** – Complete picture – Grey or colour image

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V Semester Syllabus

Semester	**V**				
COURSE TITLE	**Embedded System Design**				
COURSE CODE	**22MD5PCESD**	**Credits**	**3**	**L-T-P**	**2-1-0**
Total Hours of Pedagogy	**40**				
Pre-Requisites: Basic Electronics, ARM Processor and Programming					

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

CO1	Apply the knowledge of electronics engineering, communication protocols to design embedded systems
CO2	Design and analyze computational models for embedded systems
CO3	Evaluate performance of real time operating systems by applying knowledge of multitasking principles
CO4	Demonstrate Embedded system Design through case studies and simulation platform; present a report on the activity in a team.

CO-PO-PSO-Mapping:-

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3														
CO2		3													
CO3		3													
CO4			3		3								3		3
Avg.	**3**	**3**	**3**		**3**								**3**		3

MODULE 1	9Hrs
Embedded System Components: Embedded Vs General computing system, Classification of Embedded systems, Major applications and purpose of ES. Core of an Embedded System including all types of processor/controller, Memory, Sensors, Actuators Communication Interface (on-board and external types), I2CBus, SPI Bus, Embedded firmware, Other system components- Reset Circuit, Brown- out Circuit, Oscillator Unit, Real Time Clock(RTC), Watchdog Timer	
MODULE 2	7Hrs
Embedded System Design Concepts: Characteristics and Quality Attributes of Embedded Systems, Operational and non-operational quality attributes, Embedded Systems-Application and Domain specific, Fundamental issues in Hardware Software Co-Design, Computational models in embedded design- Source file to object file translation	
MODULE 3	8Hrs

The Embedded System Development Environment: The Integrated Development Environment (IDE), file systems, types of Files Generated on Cross-Compilation, Disassembler/Decompile, Simulators, Emulators and Debugging, Target Hardware Debugging. **Integration and Testing of Embedded Hardware and Firmware**- Out-of-Circuit Programming, In System Programming (ISP), In Application Programming (IAP), BOARD BRING UP	
MODULE 4	9Hrs
RTOS based Embedded System Design - Operating System basics, Types of operating systems, Task, process and threads, Multiprocessing and multitasking, Types of multitasking, Task scheduling, Non-preemptive scheduling, priority based scheduling, Round Robin scheduling, Task Communication, Task synchronization issues – Racing and Deadlock, Task synchronization techniques-Concept of Binary and counting semaphores	
MODULE 5	7Hrs
Case studies of Embedded system Design (Hardware and Software Architecture)- Automated Chocolate Vending Machine, Digital camera, Embedded system for Adaptive Cruise control system in a Car	

TEXT BOOKS	
1	"Introduction to Embedded Systems", by Shibu K V, Tata McGraw Hill Education Private Limited, 2nd Edition
2	Embedded systems by Raj Kamal TMH, 2nd Edition.
REFERENCE BOOKS	
1	Embedded System Design – A unified hardware and software introduction: F. Vahid (John Wiley) , 2nd edition 2018
2	Embedded Systems Design: An Introduction to Processes, Tools, and Techniques by Arnold S. Berger
Online courses	
1	https://onlinecourses.nptel.ac.in/noc20_ee98/preview
2	https://www.coursera.org/learn/introduction-embedded-systems
E-Books:	
1	http://esd.cs.ucr.edu/
2	http://dsp-book.narod.ru/ESDIPTT.pdf
Choice of Module	**Module 1 and Module 4**

Semester	V				
COURSE TITLE	SIGNAL PROCESSING				
COURSE CODE	22MD5PCSGP	Credits	4	L-T-P	3-0-1
Total Hours of Pedagogy	50				

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

CO1	**Apply the knowledge of Mathematics and Engineering to determine the types of signals and Systems.**
CO2	**Analyze, formulate problems to compute the output of an LTI system using the time domain and the frequency domain representation.**
CO3	**Design and Implement the FFT algorithms to reduce the computational complexity and to enhance the speed of operation**
CO4	**Conduct experiments and apply signal processing to interpret data for health and safety.**
CO5	**Use current techniques and modern tools to improve the Medical data analysis, document and present the same as team.**

CO-PO-PSO-Mapping:-

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3														
CO2		3											3		
CO3			3												3
CO4				3										3	
CO5					3				3	3					
Avg.	3	3	3	3	3				3	3			3	3	3

MODULE 1	6 Hrs
SIGNALS: Definition of signals and systems, Classification of signals, Basic operations on signals. Elementary signals Systems viewed as interconnection of operations, Properties of systems. **SYSTEMS:** Introduction, Time domain representation for LTI systems, Introduction to Convolution, Impulse response representation, Properties of impulse response. Convolution sum, Convolution integral. Differential and Difference equations representations, Block diagram representations.	
MODULE 2	8 Hrs

FOURIER TRANSFORM: Continuous and Discrete Time Fourier transforms & their properties Fourier transform representation of periodic signals. Applications of Fourier transform Frequency response of LTI systems. **Z-TRANSFORMS:** Introduction, Z-Transform, properties of ROC & properties of Z-Transforms. Inverse Z–transforms, Unilateral Z- Transform, Analysis of LTI Systems and application to solve Difference equations.	
MODULE 3	8 Hrs
DISCRETE FOURIER TRANSFORM: Sampling and reconstruction of a signal in the frequency domain. Definition of Discrete Fourier Transform (DFT). Properties of DFT, Circular convolution in the time domain, Use of tabular arrays and circular arrays.	
MODULE 4	8Hrs
APPLICATIONS OF DISCRETE FOURIER TRANSFORM AND FAST FOURIER TRANSFORM Use of DFT in linear filtering, linear convolution of two finite duration sequences, Overlap adds and save methods. Direct computation of DFT. Necessity for efficient computation of DFT. Radix 2, Fast Fourier Transform (FFT) algorithm for DFT computation. Decimation algorithms, Radix 2 FFT algorithm for computation of Inverse Discrete Fourier Transform. (IDFT). DCT(Discrete Cosine Transform) and its Applications (In audio video standards like MPEG, JPEG)	
MODULE 5	10 Hrs
DESIGN AND REALIZATION OF FILTERS: Introduction to realization of digital systems, block diagrams representation, Realization of Infinite Impulse Response (IIR) systems: Direct form, parallel form, cascade form. Introduction to IIR filters, Impulse invariant & Bilinear Transformations, Design of analog and digital Butterworth Filters. **Realization of Finite Impulse Response (FIR) systems:** Direct Form, Linear Phase Form. Introduction to FIR filters, Frequency response of ideal digital low pass filter, high pass filter, Frequency sampling technique of designing FIR filters, Windowing design of FIR filters using Rectangular, Kaiser and Hamming window.	

LAB EXPERIMENTS

1. Display of basic elementary signals, Sampling theorem.
2. Basic operations on sequences: Time shifting, folding, time scaling and multiplication.
3. Linear and circular convolution, Cross correlation and auto correlation.
4. Convolution and correlation using FFT algorithm.
5. FFT of a Sequence, FIR Filter design-LP, HP, BP and Notch filter.
6. FIR filters design using Hamming and Kaiser window for the given order and cut-off frequency.
7. Design of IIR Filters-Butter worth Filters.

TEXT BOOKS

1	Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab, "Signals and Systems" Pearson Education Asia / PHI, 2nd edition, 1997. Indian Reprint 2002	
2	Digital Signal Processing, Principles, Algorithms and Applications, John G.	

	Proakis, Dimitris K Manolakis, Pearson education/PHI, (4th Edition)	
REFERENCE BOOKS		
1	H. P Hsu, R. Ranjan, "Signals and Systems", Scham's outlines, TMH, 2006	
2	Ganesh Rao and SatishTunga, "Signals and Systems", Sanguine Technical Publishers, 2004	
3	Simon Haykin and Barry Van Veen "Signals and Systems", John Wiley & Sons, 2001.Reprint 2002.	
4	Digital Signal Processing, A computer based approach, Sanjit K Mitra, Tata McGrawHill, Third Edition	
VIDEO LINKS:		
1	NPTEL lecture Video on Signals and Systems by Prof. S.C.Dutta Roy, http://www.satishkashyap.com/2012/04/iit-video-lectures-on-signals-and.html	
2	NPTEL lecture Video on Signals and Systems by Prof. T.K. Basu, IIT Kharagpur. http://www.nptel.ac.in/courses/108105065/	
3	NPTEL on line Course Modules–IIT Bombay –Signals and Systems, http://www.cdeep.iitb.ac.in/nptel/Electrical%20&%20Comm%20Engg/Signals%20and%20System/TOC-M1.html	
MOOCs :		
1	https://www.edx.org/course/signals-systems-part-1-iitbombayx-ee210-1x-0	
2	https://www.edx.org/course/signals-systems-part-2-iitbombayx-ee210-2x-0	
3	https://www.coursera.org/course/dsp	
4	https://www.mooc-list.com/course/applied-digital-signal-processing	
E-books:		
1	The Scientist and Engineer's Guide to Digital Signal Processing By Steven W. Smith, Ph.D.	
2	Digital Signal Processing Principles, Algorithms, and Applications: Third Edition John G. Proakis Northeastern University Dimitris G. Manolakis	
Choice of Module: Module 2 and Module 5		

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Semester	**V**				
COURSE TITLE	**Data Structures and Algorithms**				
COURSE CODE	**22MD5PCDSA**	**Credits**	**3**	**L-T-P**	**2-0-1**
Total Hours of Pedagogy		**40**			
Pre-Requisites: C Programming					

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

CO1	Apply principles of OOPs techniques for solving problems.
CO2	Apply principles of Data Structures and Algorithm design techniques for solving problems.
CO3	Analyse and develop operations on linear and non-linear data structures
CO4	Design solutions to computing problems using appropriate data structures and algorithm design techniques.
CO5	Demonstrate data structure and algorithms coding skills on a competitive programming platform.

CO-PO-PSO-Mapping:-

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2		3											3		
CO3		3											3		
CO4			3		3								3		
CO5					3				2	2		2			3
Avg.	**3**	**3**	**3**		**3**				**2**	**2**		2	**3**		3

MODULE 1	8 Hours
Principles of Object Oriented Programming - Basic Concepts of OOPS, OOP Languages, Pre-processors directives and header files, structure of C++ program, compiling and linking, Tokens, keywords, identifiers and constants, data types. **Functions in C++:** Introduction, Main function, function prototype, call by reference, return by reference, inline functions. **Classes and objects:** Specifying a class, member functions, arrays within a class, static data members and member functions, arrays of objects, returning objects.	
MODULE 2	8Hours
Constructors and Destructors - Constructors, parameterized constructors, multiple constructors in a class, dynamic constructors and destructors. **Operator overloading and type conversions:** Overloading unary and binary operators, **Inheritance -** Introduction, defining derived classes, Types of inheritance: Single, multilevel, multiple, hierarchical, hybrid.	

MODULE 3		8 Hours
Introduction to Data Structures: Definition and its classification, Dynamic Memory Allocation Linked List: Definition, Operations on Singly linked list, Doubly linked list, Sorting techniques- bubble, quick, insertion, merge sorting techniques.		
MODULE 4		8 Hours
Stacks: Definition, Stack Operations, Queues: Definition, Queue operations, Circular queue. Binary Search Trees: Definition, Traversals, Insertion, Deletion, Applications		
MODULE 5		8Hours
Fundamentals of Algorithm Analysis: Framework for Analysis of algorithm efficiency, Asymptotic Notations, Mathematical Analysis of Non recursive algorithms and Recursive algorithms.		
TEXT BOOKS		
1	Object oriented Programming with C++, E Balaguruswamy ,TMH publications 6th edition,2015	
2	Introduction to the design and analysis of algorithms by Anany Levitin, third Edition, Pearson Education, 2017	
REFERENCE BOOKS		
1	Data Structures using C++, D.S. Malik, India edition, CENGAGE Learning, 2003	
2	Introduction to Algorithms, Cormen T.H, Leiserson C. E, Rivest R.L, Stein C, 3rd Edition, PHI 2010	
3	Object oriented Programming with turbo C++**,** Robert Lafore, GALGOTIA Publications, 2007.	
4	Data Structures using C and C++ by Yedidyah, Augenstein, Tannenbaum, 2nd Edition, Pearson Education, 2015	
5	Data Structures and Algorithm Analysis in C++, by Mark Allen Weiss, 3rd Edition, Pearson Education, 2007	
Online courses		
1	https://www.coursera.org/specializations/data-structures-algorithms	
2	https://www.coursera.org/learn/algorithms-part1	
E-Books:		
1	https://faculty.washington.edu/jstraub/dsa/Master_2_7a.pdf	
2	https://www2.cs.duke.edu/courses/fall08/cps230/Book.pdf	
3	Introduction to data structures and algorithms http://nptel.ac.in/courses/106102064/)	
List of Experiments: Programs on OOPs, Data Structures and Algorithms		
Choice of Module: Module 1 and Module 2		

COURSE TITLE	MEDICAL IMAGING MODALITIES				
COURSE CODE	22MD5PCMIM	Credits	3	L-T-P	3-0-0
Total Hours of Pedagogy	40 Hours				
Pre-Requisites: Medical Imaging Modalities					

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

CO1	Compare the basic principles of various medical imaging modalities.
CO2	Recognize the need for different medical imaging modalities.
CO3	Select the most suitable modality for a given clinical case.
CO4	Analyze the biological effects of medical imaging modalities related to human safety.
CO5	Comprehend the published reports and hospital visit observations for the selected imaging modality and document as well as communicate the same to the engineering audience.

CO-PO-PSO-Mapping:-

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3													3	
CO2		2	3											2	
CO3				3											
CO4			3												
CO5									3	3					
Avg.	**3**	**2**	**3**	**3**					**3**	**3**					

	Hours
MODULE 1	8
Introduction to imaging, myth busting of imaging, need of multimodality. **X-Rays:** Basic scientific principles of X-rays, X-ray technology, contrast, clinical applications, case study, Advanced X-ray: digital subtraction angiography (DSA), dual energy Xray absorptiometry (DXA), Orthopantomography.	
MODULE 2	8
Computer Tomography (CT): Basic scientific principles of CT, CT Technology, Contrast, clinical applications, case study, Advanced section on CT: Back projection,	

maximum intensity projection reconstruction.	
MODULE 3	8
Ultrasound: Basic scientific principles of ultrasound, Ultrasound technology, clinical applications, case study, Advanced section on Ultrasound: 3D reconstruction	
MODULE 4	8
Magnetic Resonance Imaging (MRI): Basic scientific principles of MRI - The Nuclear Spin, The MR Signal, Relaxation, Spatial Encoding, Contrast, MRI technology, Clinical Applications, case study, Advanced section on MRI: Fourier Transformation, MRI registration.	
MODULE 5	8
Diagnostic Nuclear Medicine: Basic Principles of Diagnostic Nuclear Medicine, SPECT, PET, Quality Control, case study, Advanced section on Diagnostic Nuclear Medicine: PET image reconstruction, attenuation correction. **Overview of OCT(Optical Coherence Tomography) and its Applications**	

TEXT BOOKS		
1. Introduction to Biomedical Imaging by Andrew G. Webb Wiley-IEEE Press, Nov 2017.		
2. Guy, Chris, and Dominic Ffytche. An introduction to the principles of medical imaging. London, Imperial College Press, 2005.		
REFERENCE BOOKS		
1. Smith, Nadine Barrie, and Andrew Webb. Introduction to medical imaging: physics, engineering and clinical applications. Cambridge university press, 2010.		
Online courses		
1. https://www.edx.org/course/introduction-to-biomedical-imaging		
2. https://www.edx.org/course/fundamentals-of-biomedical-imaging-ultrasounds-x-r		
3. https://onlinecourses.nptel.ac.in/noc20_ee40/preview		
E-Books:		
1. Burbridge, Brent, and Evan Mah. Undergraduate diagnostic imaging fundamentals. University of Saskatchewan, 2017. (https://undergradimaging.pressbooks.com/;https://openpress.usask.ca/undergradimaging/		
2. Maier, Andreas, Stefan Steidl, Vincent Christlein, and Joachim Hornegger, eds. "Medical imaging systems: An introductory guide.", 2018. https://link.springer.com/book/10.1007%2F978-3-319-96520-8		
Changes made in the existing Syllabus: NIL 1. Case studies are introduced for each unit		

% of Changes made in existing syllabus: 20%		
Which University syllabus has been referred while preparing the syllabus		
1. Queensland University, Australia **2.** Indian Institute of Technology, Madras		
Unit Choice: Module 4 and Module 5		

Semester	**V**				
COURSE TITLE	**Medical Data communication & Informatics**				
COURSE CODE	**22MD5PCMDI**	**Credits**	**3**	**L-T-P**	**2:1:0**
Total Hours of Pedagogy	**40**				
Pre-Requisites: Basics of mathematics, signals and systems,					

Course Outcomes:	
CO1	Apply the knowledge of mathematics, science and engineering to develop concepts for data communication systems
CO2	Formulate ,analyze appropriate solution for medical data communication systems and informatics
CO3	Conduct experiments to analyze the appropriate communication system for medical data communication and informatics using modern tools
CO4	Recognize the ethical and safety considerations related to the use of medical data communication.
CO5	Design an open ended experiment for medical data communication/ informatics in a group present and document the same.

CO-PO/PSO mapping: At the end of the course the students will be able to,

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2		3											3		
CO3		3			3								3		
CO4		3				2							3		
CO5				3					2	2			2		
Avg	3	3		3	3	2			2	2			3		

MODULE 1	
Introduction to Analog and Digital Communication: Introduction and Applications. Amplitude Modulation: Virtues, Limitations. Angle Modulation: Basic Definitions, Properties of Angle-Modulated Waves, Relationship between and FM Waves Transmission Bandwidth of FM Waves, Generation of FMwaves, Demodulation of FM Signals. **Pulse Modulation**: Transition from Analog to Digital Communications: Sampling Process, PAM,Completing the Transition from Analog to Digital, Quantization Process, PCM, Delta Modulation.	8
MODULE 2	
Digital Band-Pass Modulation Techniques: Binary Amplitude Shift Keying (BASK): Generation and Detection, Binary Phase Shift-Keying (BPSK): Generation and Detection, Quadriphase Shift Keying (QPSK): Generation and Detection, Binary Frequency Shift Keying (BFSK), **Biotelemetry** :ECG telemetry system ,Temperature telemetry system,. Multi-Channel wireless telemetry system, Transmission of physiological signals over telephone . Telemedicine .Wireless telemetry.	**7**
MODULE 3	
Wireless Personal Area Networks (WPAN): Network Architecture, WPAN Components, WPAN Technologies and protocols (Bluetooth & Zigbee), WPAN Applications. **Wireless Wide Area Networks**: Cellular Networks: Principles, GSM, CDMA	8
MODULE 4	
Introduction to Health informatics: Hospital Information System – its characteristics and functional online and offline modules, Health Informatics, Bioinformatics, Medical Informatics, Clinical Informatics, imaging Informatics, Nursing Informatics, Public Health Informatics, e – health services, Evidence Based Medicine, Bioethics, Virtual Hospital, Consumer Health Informatics and Healthcare Data Analytics.	8
MODULE 5	
ELECTRONICS PATIENT RECORDS AND STANDARDS Electronic Patient Record, Medical data formats, – Medical Standards and Organizations – HL7 – DICOM - IRMA - LOINC - PACS - Medical Standards for Vocabulary - ICD 10, DRGs, MeSH, UMLS, SNOMED – JCAHO – HIPAA.	7
Text Books	
1 Simon Haykin, John Wiley & sons, "Introduction to Analog and Digital Communications"-Second Edition, 2012, ISBN 978-81-265-3653-5.	
2 Dr. Sunil Kumar S.Manvi, Mahabaleshwara S. Kakkasageri, "Wireless and Mobile NetworksConcepts and Protocols", John Wiley & sons, 2014 Edition, ISBN 978-81-265-2069-	
3 Mohan Bansal M S, Medical Informatics, Tata McGraw Hill Publishing Company, New Delhi, 2005.computer vision	
Reference Books:	
1 John G Proakis and MasoudSalehi, "Fundamentals of Communication Systems", 2014. Edition, Pearson Education, ISBN 978-8-131-70573-5.	

2	Ian A Glover and Peter M Grant, "Digital Communications", Pearson Education, ThirdEdition, 2010, ISBN 978-0-273-71830-7.	
3	B. P. Lathi and Zhi Ding, "Modern Digital and Analog communication Systems", Oxf	
Online courses:		
1	www.bu.edu › BU Online Home › Programs study.com/.../Online_Graduate_Courses_and_Classes_in_Healthcare_Inf...	
2	https://www.umb.edu/academics/caps/certificates/healthcare_informatics	
E-Books:		
1	www.springer.com/in/book/9782817804774	
2	ebooks.himss.org/product/medical-informatics-executive-primer	
Choice of Module: Module 3 and Module 4		

Semester	**V**				
COURSE TITLE	**VLSI Design**				
COURSE CODE	**22MD5PE1VL**	**Credits**	**3**	**L-T-P**	**3:0:0**
Total Hours of Pedagogy	**40**				
This Program Electives will have an integrated Lab and will be conducted as 2-0-1 (2 Hrs theory and a Lab session per week)					
Pre-Requisites: Basic Electronics and Digital Electronics					

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

CO1	Apply the knowledge of digital electronics fundamentals for VLSI design.
CO2	Design CMOS based circuits for given specifications.
CO3	Analyze and evaluate the performance and characteristics of VLSI designs.
CO4	Evaluate basic circuit concepts in CMOS Design and the Scaling of MOS Circuits with scaling factors for device parameters in MOS circuits.
CO5	Conduct experiments using appropriate tools to verify the correctness and functionality of CMOS circuits.

CO-PO-PSO-Mapping:-

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3														
CO2			3												

CO3		3													
CO4				3					3	3					
CO5					3										2
Avg.	**3**	**3**	**3**	**3**	**3**				**3**	**3**					**2**

MODULE 1	**8hours**
Logic Design with MOSFETs: MOSFETs as Switches, Basic logic gates in CMOS, Complex logic gates in CMOS, Transmission Gate Circuits.	
MODULE 2	**8hours**
Physical Structure of CMOS Integrated Circuits: Integrated Circuit Layers, Interconnect Resistance and Capacitance, MOSFETs CMOS layers, Designing FET Arrays, Complex logic gates, Gate layout geometry, Euler graph.	
MODULE 3	**8hours**
Electronic Analysis of CMOS Logic Gates: DC Characteristics of the CMOS inverter, Inverter Switching Characteristics, Power dissipation, DC Characteristics: NAND and NOR Gates.	
MODULE 4	**8hours**
Basic circuit concepts: sheet resistance R, sheet resistance concept applied to MOS transistor and inverter, area capacitances of layers, standard unit of capacitance Cg, some area capacitance calculation, the delay unit τ, inverter delays, driving large capacitance loads, propagation delays, wiring capacitance, choice of layers.	
MODULE 5	**8 hours**
Scaling of MOS circuits: Scaling models and scaling factors for device parameters, some discussions on scaling and limitations of scaling, subsystem design and layout. Some architectural issues switch logic gate restoring logic. Examples of structured design	

TEXT BOOKS	
1	John P. Uyemura, "Introduction to VLSI Circuits & Systems", Wiley India Edition, 2007, ISBN: 978-81-265-0915-7
2	Basic VLSI design- Dougles A Pucknell, 3rd edition, PHI
REFERENCE BOOKS	
1.	Principles of CMOS VLSI design-Neil West and Eshranghian, 2nd edition, Addison Wesley, 2002.
2.	M.S.Suma,Poornima M,Namita Palecha,CMOS VLSI Design, New Age International,1st Edition 2017.
Online courses	
1.	ElectronicDesignAutomationhttp://nptel.ac.in/courses/VLSI Fundamentals
E-Books:	
1	http://access.ee.ntu.edu.tw/course/dsd_99second/2011_lecture/W2_HDL_Fundamentals_2011-03-02.pdf

List of Experiments: Tools -Any EDA tool

UNIT 1: MOSFETs as Switches

i. Experiment 1: Study of the characteristics of n-MOS and p-MOS transistors as switches.
ii. Experiment 2: Design and construction of a CMOS inverter.
iii. Experiment 3: Study of the switching characteristics of a CMOS inverter.

UNIT 2: Physical Structure of CMOS Integrated Circuits

i. Experiment 4: Study of the different layers used in CMOS integrated circuits.
ii. Experiment 5: Measurement of the resistance and capacitance of the different layers.
iii. Experiment 6: Design and construction of a CMOS logic gate.

UNIT 3: Electronic Analysis of CMOS Logic Gates

i. Experiment 7: Study of the DC characteristics of a CMOS inverter.
ii. Experiment 8: Study of the switching characteristics of a CMOS inverter.
iii. Experiment 9: Measurement of the power dissipation of a CMOS logic gate.

UNIT 4: Basic Circuit Concepts

i. Experiment 10: Study of the sheet resistance concept.
ii. Experiment 11: Calculation of the area capacitances of the different layers.
iii. Experiment 12: Measurement of the delay of a CMOS inverter.

UNIT 5: Scaling of MOS Circuits

i. Experiment 13: Study of the scaling models for MOS circuits.
ii. Experiment 14: Design and construction of a scaled CMOS logic gate.
iii. Experiment 15: Study of the limitations of scaling CMOS circuits.

Choice of Module: Module 1 and Module 4

Semester	**V**				
COURSE TITLE	**MOBILE AND WEB APPLICATION DEVELOPMENT**				
COURSE CODE	**22MD5PE1MW**	**Credits**	**3**	**L-T-P**	**3-0-0**
Total Hours of Pedagogy	**40**				
This Program Electives will have an integrated Lab and will be conducted as 2-0-1 (2 Hrs theory and a Lab session per week)					
Prerequisites- knowledge of Programming					

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

CO1	Apply the knowledge of constructs in Java and XML to obtain feasible modules as a solution for engineering problems. PO1
CO2	Analyse packages, project libraries and services to obtain a framework for solving problems in development of mobile applications. PO2

CO3	Obtain the code patterns by investigating resources to arrive at valid conclusions. PO4, PO5
CO4	Create GUI programs based on common controls, themes, actions, components, handlers and mapping packages using Android Studio/SDK. PO4, PO5
CO5	Design mobile Apps to provide solutions for real world problems by incorporating multidisciplinary settings. PO3

CO-PO PSPO Mapping:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3														3
CO2		3	2												3
CO3				2	3										3
CO4				3	3										2
CO5			3												2
Avg.	**3**	**3**	**2.5**	**2.5**	**3**										2.6

MODULE 1	8
Setting up Android studio environment, Learning Android's fundamental components, Defining UI through layout files, Implementing programming logic, Updating AndroidManifest.xml, Placing files in Android project, Android activity life cycle, More on resources and intents, UI development in Android, Android's common controls: Text, Button, Imageview, Date & Time, Mapview	
MODULE 2	8
Understanding Adapters, Using adapters with AdapterViews: Listview, Gridview, Spinner, Gallery, Creating custom adapters, Understanding layout managers, Working with menus through XML files and Java code, expanded menus, Icon menus, Submenus, Context menus, Dynamic menus, Exploring action bars, Implementing standard action bar, Tabbed action bar, List-based action bar, Styles and Themes	
MODULE 3	8
Structure and life cycle of fragment, Understanding dialog fragments, Exploring preferences framework, Packages and processes, Code pattern for sharing data, Understanding library projects, components & threads, handlers.	
MODULE 4	8

Intro to HTML and CSS: Syntax, elements, HTML structures, CSS Selectors, properties, and values, building first web page. HTML Fundamentals: Semantics, Block and inline elements, text, structure, Hyperlinks, tables, forms.	
MODULE 5	8
CSS Fundamentals: Cascading effect, specificity, combining and layering selectors, colors, reset. Positioning: Box model, floats, inline blocks, precise positioning, website clone/ HTML CSS Project	

TEXT BOOKS	
1.	Native Mobile Development: A Cross Reference for iOS and Android 1st Edition, by Shaun Lewis and Mike Dunn, 2019
2.	HTML and CSS: Design and Build Webs Paperback – Illustrated, 18 November 2011 by Jon Duckett

REFERENCE BOOKS	
1	Android Programming: The Big Nerd Ranch Guide, 4th Edition by Bill Phillips, Chris Stewart, Kristin Marsicano, Brian Gardner, Released October 2019, Publisher(s): Big Nerd Ranch Guides Expert Android Studio, Murat Yener, Onur Dundar, Wrox publications, 2017.
2	Enterprise Android, Zigurd Mednieks, G Blake Meike, Laird Dornin, Zane Pan, Wrox publications, 2014

Online courses	
1	https://www.coursera.org/specializations/android-app-development
2	https://in.udacity.com/course/android-basics-user-interface--ud834

E-Books:	
1	http://www.techotopia.com/index.php/Android_Studio_Development_Essentials_-_Android_6_Edition
2	http://www.kmvportal.co.in/Course/MAD/Android%20Book.pdf

List of Experiments: 1. Develop a mobile application that uses GUI components to manipulate Font and Colors. 2. Develop a mobile application that uses Layout Managers and event listeners. 3. Develop a native calculator using mobile application. 4. Write a mobile application that draws basic graphical primitives on the screen. 5. Develop a mobile application that makes use of database to insert and display the student data. 6. Develop a mobile application that makes use of database to update, delete and display all the student data. 7. Develop a mobile application that uses GPS location information. 8. Implement a mobile application that creates an alert upon receiving a message. 9. Write a mobile application that creates alarm clock. 10. HTML Layouts and links 11. Web App design and formatting Responsive interface using Bootstrap	
Choice of Module: Module 4 and Module 5	

Semester	V		
Course Title	Project–1	Course Code	22MD5PWPJ1
Credits	2	L-T-P	0-0-2

Course Outcomes	
CO1	Ability to apply knowledge to identify, gather information and analyse to formulate the unmet need and problem definition for project through survey
CO2	Ability to use appropriate tool/tools to implement and demonstrate the project.
CO3	Ability to design and develop sustainable solution/system for the biomedical applications.
CO4	Ability to make effective presentation of the work abiding professional ethics as an individual and a team member.
CO5	Ability to develop systems with scope for enhancement and continue life-long learning.

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	3		3									3	3	3
CO2					3								3	3	3
CO3			3			3	3						3	3	3
CO4								3	3	3	3				
CO5												3			
Avg.	**3**	**3**	**3**	**3**	**3**	3	3	3	**3**	**3**	3	3	**3**	3	3

Guidelines for Mini Project–1 (22MD5PWPJ1)
Objective: The objective of this open ended mini project is to let the students apply the knowledge of the engineering subjects into a **real- world situation/problem**.
Guidelines:
1. The mini project to be done in a group of 3 / 4 students.
2. Mini project can be done in the area of medical electronics engineering using the knowledge gained from the courses studied in the lower semesters .
3. Mini project must be hardware project with associated software component for it. **(**considering current technology/situation)
4. Each group will be allotted a **Guide**. Students in that group must discuss the project idea with Guide before finalizing it.

5. Each group will present the idea of the project and will submit 1 - 2 page(s) of an **Abstract** of the mini project work.
6. Every week, project group will report progress of the project to allotted Guide.
7. Each group will give progress presentations according to the schedule. .
8. At the end of the project, all groups will submit video of the working model and technical report in the format shared.
9. Final SEE will be conducted for 50 marks.

Semester	**V**				
COURSE TITLE	**BIOMEDICAL WASTE MANAGEMENT**				
COURSE CODE	**22MD5HSBWM**	**Credits**	**1**	**L-T-P**	**0:1:0**
Total Hours of Pedagogy	**20**				
Pre-Requisites: Hospital visit/internship.					

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

CO1	Apply the knowledge of Health care waste for Biomedical waste segregation
CO2	Analyze the process of waste segregation and waste treatment for the disposal of Biomedical waste
CO3	Engage students for a field visit to comprehend the idea for biomedical waste management through case study and communicate the same by poster presentation.

CO-PO-PSO-Mapping:-

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												2		
CO2		3											2		
CO3					3	2	2		2	2			2		
Avg.	**3**	**3**			**3**	2	2		**2**	**2**			**2**		

MODULE 1		3
BASIC CONCEPTS: Healthcare waste, Categorization & Classification of Healthcare waste, Steps involved in Bio-medical Waste Management, Bio medical waste segregation, Color coding and types of Container/bag, Storage, Biomedical waste collection, In house transportation, Central waste collection of Biomedical waste		
MODULE 2		3
SEGREGATION, TREATEMENT AND DISPOSAL OF BIOMEDICAL WASTE: Treatment option for Bio-medical waste, Yellow-Red-White-Blue category, Spill management procedure, Standards for treatment and disposal, Standards for Deep burial, design of concrete pit for waste sharps, Effluent Treatment Plant		
MODULE 3		3
OUT REACH ACTIVITIES: Responsibility, Outreach activities, Steps for BWM for outreach activities, Bio-medical waste management by occasional waste generators.		
MODULE 4		3
MANAGEMENT REQUIREMENTS: Role of Health care facility, Authorization, Reporting to State Pollution Control Board or Pollution Control Committee, Occupational Safety, Immunization, Training of Health care workers, Monitoring and review, Liability of Healthcare facility.		
MODULE 5		3
MANAGEMENT OF GENERAL AND OTHER WASTES: General Requirements for HCFs, Used Batteries, Radioactive wastes and e-wastes.		
TEXT BOOKS		
1	Tweedy, James T., Healthcare hazard control and safety management-CRC Press_Taylor and Francis	
2	Anantpreet Singh, Sukhjit Kaur, Biomedical Waste Disposal, Jaypee Brothers Medical Publishers (P) Ltd	
REFERENCE BOOKS		
1	R.C.Goyal, Hospital Administration and Human Resource Management, PHI – Fourth Edition	
2	V.J. Landrum, Medical Waste Management and disposal, Elsevier	
Online courses		
1	https://archive.nptel.ac.in/courses/120/108/120108005/	
2	https://dth.ac.in/medical/courses/Microbiology/block-9/3/index.php	
E-Books:		
1	https://cpcb.nic.in/uploads/Projects/Bio-Medical-Waste/Guidelines_healthcare_June_2018.pdf	
2	https://cpcb.nic.in/uploads/Projects/Bio-Medical-Waste/Pictorial_guide_covid.pdf	
	Project ideation through poster presentation &Viva – 30 Marks **CIE Test 1: MCQ – 20 marks** **Total CIE: 50 Marks.** **SEE: MCQ – 50 marks**	

Semester	V		
Course Title	Human Values through Literature	Course Code	22MD5NCHVL
Credits	NCMC	L-T-P	------

The aim of the course is to conserve values like truthfulness, kindness, honesty, law, justice, patriotism, humanism, etc. in society and eliminate negative attitudes. The course explores how Literature can be effective to inculcate human values.

At the end of the course, the student will have the ability to understand the significance of human values and responsibility in a society.

Ability to apply the knowledge of human values acquired through Indian literature in the form of a play/report.

Ability to analyze and write reports from different literary works

Method of evaluation: Students will study Indian literary works and present it as a play/report/quiz in groups of four to six students which will be evaluated by the faculty in- charge for Pass/No Pass.

VI Semester Syllabus

Semester	**VI**				
COURSE TITLE	**Medical Image Processing**				
COURSE CODE	**22MD6PCMIP**	**Credits**		**L-T-P**	**3-0-1**
Total Hours of Pedagogy	**50**				
Pre-Requisites: Medical Imaging, Signal Processing					

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

CO1	Apply the basic concepts of digital image representation and understand the objectives of biomedical image analysis and CAD.
CO2	Apply digital image processing algorithms for medical image enhancement, restoration and segmentation
CO3	Conduct experiments for medical image analysis using modern tools
CO4	Develop Graphical user interface based mathematical models for medical image enhancement and segmentation.
CO5	Implement an open ended experiment for medical image segmentation and prepare the technical document on it.

CO-PO-PSO-Mapping:-

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3														
CO2		3													
CO3		3			3				3					**3**	3
CO4			3		3				3					**3**	3
CO5	3	3	3	3	3				3					**3**	3
Avg.	**3**	**3**	**3**	**3**	**3**				**3**					**3**	**3**

MODULE 1	8Hrs
Fundamentals: Introduction, Fundamental steps in DIP, Components of DIP system, A simple image formation model, Image sampling and quantization, Basic relationship between pixels, Color image processing fundamentals related with all color Models, Types of Medical Images, Objectives of Biomedical Image Analysis, Computer Aided Diagnosis, Image Quality and Information Content	
MODULE 2	10Hrs

Image Enhancement in Spatial Domain: Background, Point processing – Image negatives, Log transformations, Power law transformations, Contrast stretching, Gray level slicing, Bit plane slicing, Histogram processing–Histogram equalization, Local enhancement, Arithmetic/Logic operations – Image subtraction, Image averaging, Basics of spatial filtering, Smoothing spatial filters – Smoothing linear filters, order statistics filters Sharpening spatial filters – Foundation, The Laplacian, The Gradient.	
MODULE 3	7Hrs
Image Enhancement in Frequency Domain: Background, Basic properties of the frequency domain, Basic filtering in the frequency domain, Basic filters and their properties,Smoothing frequency domain filters – Ideal low pass filters, Butterworth lowpass filters,Gaussian lowpassfilters, Sharpening frequency domain filters – Ideal high pass filters,Butterworth highpassfilters, Gaussian highpass filters, Homomorphic filtering.	
MODULE 4	7Hrs
Image Restoration: Characterization of Artifacts, Image degradation/restoration model, Examples of noise PDFs, Structured noise Physiological interference, Other types of noise and artifact, Restoration using spatial filtering – Mean filters, Geometric mean filters, Harmonic mean filters, Median filter, Max & min filters, Midpoint filter, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering	
MODULE 5	8Hrs
Detection of Regions of Interest: Thresholding and Binarization, Optimal thresholding Detection of Isolated Points and Lines, Edge Detection, The Laplacian of Gaussian, Region Growing, Splitting and merging of regions. Image Representation and Description: Representation, Boundary descriptors.	

TEXT BOOKS

1.	Digital Image Processing by Rafael C. Gonzalez & Richard E. Woods, Third Edition, Pearson Education Inc.
2.	Biomedical Image Analysis by Rangaraj M Rangayan by CRC Press 2004

REFERENCE BOOKS

1.	Image Processing, Analysis and Machine Vision by Milan Sonka, Third edition on, The MIT Press
2.	Handbook of Medical Image Processing and Analysis, 2nd Edition, Academic Press

Online courses

1.	https://www.coursera.org/course/images.
2.	https://nptel.ac.in/courses/108/105/108105091/

E-Books:

1.	http://ultra.sdk.free.fr/docs/DxO/Digital%20Image%20Processing%20for%20Medical%20Applications.pdf
2.	www.dcc.uchile.cl/~jsaavedr/libros/dip_gw.pdf

3.	iclass.iuea.ac.ug

List of Experiments:

1. Image Display, conversion to different color space models, image negative
2. Medical Image enhancement in spatial domain
3. Implementation of spatial filters on medical images
4. Implementation of algorithms for image enhancement in frequency domain
5. Image restoration for medical images
6. Medical Image segmentation using various algorithms

In each experiment various subparts will be included

Choice of Module: Module 2 and Module 5

Semester	**VI**		
Course Title	**Machine Learning for Medical Engineering**	**Course Code**	22MD6PCMLM
Credits	3	**L-T-P**	**2:0:1**
Total Hours of Padagogy	**40**		

Pre Requisites: Linear Algebra and Probability concepts

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

CO1	Formulate any given data-oriented problem as a machine learning and deep learning problem
CO2	Choose and perform the different types of data pre-processing required to clean the data and remove noise.
CO3	Choose and perform the suitable feature extraction and machine learning model on the given data.
CO4	Formulate experiments and analyze the practical performance of the machine learning model for a given task.

CO-PO/PSO mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3														
CO2		3													
CO3			3												
CO4				3	2										3
Avg.	**3**	**3**	**3**	**3**	**2**										**3**

MODULE 1	6 Hrs
Introductory class: Overview of the required math, Introduction to Machine Learning, what will be covered in the class, Introduction to python and Scikit-Learn package. **Components of a machine learning project:** Working with real data, Get and visualize the data, Prepare the data for machine learning, Select train and fine tune your model. **Linear and polynomial regression.**	
MODULE 2	**9 Hrs**
Classification: Binary classification, Multi-label classification, Performance measures: confusion matrix, ROC curve. **Support Vector Machines (SVM):** Linear SVM classification, Nonlinear SVM classification, SVM regression **Application: Cognitive State detection**	
MODULE 3	**9 Hrs**
Decision Trees: Training and visualizing a decision tree, making predictions, Estimating class probabilities, The CART algorithm k-nearest neighbours (knn), Bias-Variance trade-off and error analysis, Model selection and feature selection **Application: Tumor Type Prediction, Bioinformatics, fMRI data**	
MODULE 4	**7 Hrs**
K-means clustering: Algorithm, Initialization, Getting stuck, K-means for image segmentation. **Application: Gene Expression** **Dimensionality reduction:** Approaches -- projection and manifold learning, Principal Component Analysis (PCA), Choosing the right number of dimensions, PCA for compression. **Application: drug discovery, EEG analysis**	
MODULE 5	**9 Hrs**
Deep Learning (DL) and Neural Networks: Introduction to DL, Neural Network Basics, Different DL architectures and intro to DL frameworks, fully connected Deep Network, Convolutional Neural Network. Evaluating and debugging learning algorithms, Practical advice on structuring an ML project **Application: Medical Imaging, ECG, EEG data**	

Text Books	
1	Theobald, Oliver. Machine learning for absolute beginners: a plain English introduction. Scatterplot press, 2017.
2	Müller, Andreas C., and Sarah Guido. Introduction to machine learning with Python: a guide for data scientists. " O'Reilly Media, Inc.", 2016.
Reference Books:	
1	Géron, Aurélien. Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow. " O'Reilly Media, Inc.", 2022.
Online courses:	
1.	https://www.simplilearn.com/learn-machine-learning-basics-skillup
2.	https://developers.google.com/machine-learning/crash-course

E-Books:	
1.	https://mml-book.github.io/book/mml-book.pdf
2.	https://www.ibm.com/downloads/cas/GB8ZMQZ3
3.	https://www.deeplearningbook.org/

Lab Experiments

1. Introduction to Python: Data preprocessing, Exploratory Data Analysis
2. Data Processing: Missing values and data preparation.
3. Linear Regression
4. Multiple regression
5. Support vector machine
6. Logistic Regression
7. Navie Bayes Classification
8. Decision Trees
9. Random Forest Classification
10. Feature Selection Techniques

Choice of Module: Module 4 and Module 5

Semester	**VI**		
Course Title	**Biomedical Signal Processing**	**Course Code**	**22MD6PCBSP**
Credits	**4**	**L-T-P**	**3-1-0**
Total Hours of Pedagogy	**50**		

Pre Requisites: Biomedical instrumentation, signal and systems, DSP

Course Outcomes:

CO1	Apply knowledge of mathematics, Engineering science to solve the problems in biomedical signal processing steps.
CO2	Analyze a problem and formulate appropriate solution for biomedical signal applications.
CO3	Applications to the biomedical signals and analyze them through computer based process through signal processing algorithms.
CO4	Design formulate and implement experiments using modern tools to meet the desired needs in healthcare.
CO5	Perform simulation on the problems related to biomedical signals and present and document the same in groups.

CO-PO/PSO mapping : At the end of the course the students will be able to,

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2	3	3											3		
CO3			3										3		
CO4				3	3					3	3		3		
CO5										3	3		3		
Avg	3			3	3					3	3		3		

MODULE 1	8
Preliminaries: Biomedical signal origin & dynamics: Filtering for Removal of artefacts: Statistical Preliminaries, Time domain filtering -Synchronized Averaging, Moving Average, Time domain filtering-Moving Average Filter to Integration, Derivative-based operator, Frequency Domain Filtering -Notch Filter, Optimal Filtering, The Weiner Filter. Adaptive Filtering. Principle of an adaptive filter, the steepest descent algorithm, adaptive noise canceller, cancellation of 50 Hz and power line interference in electrocardiography, applications of adaptive filters.	
MODULE 2	12
Data Compression Techniques: ECG Data Reduction: Direct data compression Techniques: Turning Point, AZTEC, Cortes, FAN, Transformation Compression Techniques: Karhunen - Loeve Transform, Other data compression Techniques: DPCM, Huffman coding, Data compression Techniques comparison. **Signal Averaging**: Basics of signal averaging, Signal averaging as a digital filter, A typical averager, Software and limitations of signal averaging.	
MODULE 3	10
Cardio logical Signal Processing: ECG waveform analysis, ECG Parameters and their estimations: ECG QRS Detection techniques, estimation of R-R interval, estimation of ST segment inclination, Rhythm analysis, arrhythmia analysis monitoring, long term continuous ECG recording, ECG signal analysis case studies	
MODULE 4	8
Neurological signal processing: Introduction, Linear prediction theory, The Autoregressive (AR) method, Recursive estimation of AR parameters, Spectral error measure, Adaptive segmentation, EEG Transient detection and elimination in epileptic patients and its overall performance. Illustration of the Problems in an EEG signals with Case Studies.	
MODULE 5	12
PSD estimation methods : Event Detection and waveform analysis: Need for event detection, Detection of events & waves, Correlation analysis of EEG signals, The matched filter, Detection of the P wave, Identification of heart sounds, Morphological analysis of ECG waves, analysis of activity. **Sleep EEG**: Data acquisition and classification of sleep stages, The Markov model and Markov chains, Dynamics of sleep-wake transitions, Hypnogram model parameters, Event	

history analysis for modelling sleep. Monitoring of sleep apnea by polysomnography.		
Text Books		
1	Biomedical Signal Processing- principles and techniques, by D.C.Reddy, Tata McGraw-Hill, 2005	
2	Biomedical Signal Processing Time and Frequency Domains Analysis (Volume I)- Arnon Cohen, CRCpress, 1986.	
3	Rangaraj M. Rangayyan – Biomedical Signal Analysis. IEEE Press, 2015 .	
Reference Books:		
1	Biomedical Digital Signal Processing, Willis J.Tompkins, PHI,	
2	Biomedical Signal Processing in Cardiac and Neurological Applications", Leif Sörnmo & Pablo Laguna, 1stedition, Academic Press, 2005	
Online courses:		
1	ocw.mit.edu › Courses › Health Sciences and Technology MIT Open Course Warhttp://ocw.mit.edu	
2	www.vub.ac.be/en/study/fiches/30340/biomedical-signals-and-images www.crcpress.com › Biomedical Science › Biomedical Imaging downloads.hindawi.com/journals/special issues/129194.pdf	
E-Books:		
1	Advanced Methods of Biomedical Signal Processing edited by Sergio Cerutti, Carlo Marchesi Biological Signal Analysis By Ramaswamy Palaniappan	
Lab Component		
List of Experiments: 1. To Read and Plot ECG data with Random noise 2. To Read and Plot ECG data with 50Hz sinusoidal noise 3. Signal Averaging method for a given data 4. Design of Notch- filter to remove noise in ECG 5. Convolution Property of ECG signals 6. Study experiment on Adaptive filters 7. Design of FIR filter to remove noise in ECG 8. Design of IIR filter to remove noise in ECG 9. Data compression using Turning Point Algorithm using C and Matlab 10. QRS Detection Method1 11. QRS Detection Method2 12. To Read and Plot EEG data, Power Spectrum of EEG **13.** Study experiment on Adaptive-segmentation		
Alternate Assessment Test1:- case study on biomedical signal processing implementation		
Choice of Module: Module 2 and Module 5		

Semester	**VI**				
COURSE TITLE	**Wearable Sensors and Medical IoT**				
COURSE CODE	**22MD6PE2WI**	**Credits**		**L-T-P**	**3-0-0**
Total Hours of Pedagogy	**40**				
This Program Electives will have an integrated Lab and will be conducted as 2-0-1 (2 Hrs theory and a Lab session per week)					
Pre-Requisites: Basic knowledge of Sensors and IoT					

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

CO1	Apply the knowledge of science, engineering and measurement fundamentals to develop wearable sensors.
CO2	Analyze the trade-offs in security designs and determine accountability, in order to formulate solutions using wearable sensors.
CO3	Develop solutions for secured communication in medical IoT and Implanted medical devices.
CO4	Conduct experiments on communication technologies used in medical IoT, both as individuals and in teams, and communicate the results to an engineering community.

CO-PO-PSO-Mapping:-

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3												3		
CO2		3											3		
CO3			3										3		
CO4				3					3	2			3		
Avg.	**3**	**3**	**3**	**3**					**3**	**2**			**3**		

MODULE 1	
Introduction to Wearable sensors: Physical and Biophysical parameters measured, Types, Characteristics and Working principles of wearable sensors. Electrochemical and Piezoelectric wearable sensors. Principle, design and development of wearable medical devices: Fingertip Photoplethysmography for Estimation of SpO2, and Heart rate monitoring.	8
MODULE 2	
Medical IoT systems: Introduction, Communication Protocols, System processes, Secure routing: Problems and solutions. The Cloud-side communication – MQTT Protocol. IoT for Wearable devices: Access control and identity management. Challenges, and Approaches to IoT Security.	7
MODULE 3	

Wearable body sensor networks (WBSN): Generalized system architecture. System Architecture and Signal Processing Flow. Security requirements in a WBSN, Threats and attacks, Possible solutions for security and privacy in WSBN.	5
MODULE 4	
Cybersecurity for wireless implants: Implantable medical devices (IMDs) – Introduction and Examples, Communication in IMDs. Ethical hacking highlights, IMD security issues, Trade-offs in security designs, Supporting emergency access.	6
MODULE 5	
Design of Wireless Health Platforms: System Architecture Requirements for Wireless Health Platforms, System Design. MicroLEAP: A Wireless Health Platform with Integrated Energy Accounting. MicroLEAP Application: SmartCane.	5

TEXT BOOKS	
1.	Subhas Chandra Mukhopadhyaay and Tarikul Islam, Wearable Sensors, IOP publishing, 2017
2.	Annalisa Bonfiglio, Danilo De Rossi, Editors, Wearable Monitoring systems, Springer, 2011
REFERENCE BOOKS	
1.	Nilanjan Dey , Amira S. Ashour Simon James Fong, Editors, Wearable and Implantable Medical Devices, Academic press
2.	Edward Sazonov, Wearable Sensors: Fundamentals, Implementation and Applications, 2nd edition , Academic Press, 2020
Online courses	
1.	https://www.udemy.com/course/wearable-technology-a-complete-primer-on-wearables/
E-Books:	
1.	https://www.intechopen.com/books/wearable-technologies/advances-in-wearable-sensing-technologies-and-their-impact-for-personalized-and-preventive-medicine

List of Experiments: To be conducted on an IoT kit

1. Blink a RGB LED
2. Push Button with LED
3. DHT11 Interfacing with Arduino
4. Interfacing relay with AC applications
5. Reading analog value from real world
6. Interfacing Pressure sensor - BMP280
7. Interfacing of 3-Axis Accelerometer and Gyro Sensor - MPU6050
8. Interfacing of TFT screen

Choice of Module: Module 1 and Module 2

Semester	VI				
COURSE TITLE	Clinical Data Analytics				
COURSE CODE	22MD6PE2CD	Credits	3	L-T-P	3:0:0
Total Hours of Pedagogy	40				
This Program Electives will have an integrated Lab and will be conducted as 2-0-1 (2 Hrs theory and a Lab session per week)					
Pre-Requisites: Engineering Mathematics					

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

CO1	Apply the knowledge to understand the basic concepts of biostatistics and their application in clinical data analysis.
CO2	Analyse descriptive statistics techniques for healthcare data.
CO3	Design and conduct hypothesis tests for various scenarios in clinical research.
CO4	Analyse linear regression and correlation analysis, including regression modeling and make inferences about the relationships.

CO-PO-PSO-Mapping: -

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**														
CO2		**3**													
CO3			**3**						**2**	**2**					
CO4		**3**													**2**
Avg.	**3**	**3**	**3**						**2**	**2**					**2**

MODULE 1	Hours
Introduction to Biostatistics: Introduction, Some basic concepts, Measurement and Measurement Scales, Simple random sample, Computers and biostatistical analysis. Descriptive Statistics: Introduction, ordered array, grouped data-frequency distribution and descriptive statistics – measure of central tendency, measure of dispersion and measure of central tendency computed from grouped data, variance and standard deviation-grouped data.	**8hours**
MODULE 2	
Basic Probability Concepts: Introduction, two views of probability – objective and subjective, elementary properties of probability, calculating the probability of an event. Probability Distributions: Introduction, probability distribution of discrete variables, binomial distribution, Poisson distribution, continuous probability distributions, normal	**8 hours**

distribution and applications.	
MODULE 3	
Sampling Distribution: Introduction, sampling distribution, distribution of the sample mean, distribution of the difference between two samples means, distribution of the sample proportion, distribution of the difference between two sample proportions.	8 **hours**
MODULE 4	
Hypothesis Testing: Introduction, hypothesis testing – single population mean, difference between two population means, paired comparisons. The Type I and II Error and the Power of a test.	**8hours**
MODULE 5	
Linear Regression and Correlation: Introduction, regression model, sample regression equation, evaluating the regression equation, using the regression equation, correlation model, correlation coefficient.	**8 hours**

TEXT BOOKS

1.	Biostatistics: A Foundation for Analysis in the Health Sciences, 11th Edition Wayne W. Daniel, Chad L. Cross, Wiley publishers, 2018

REFERENCE BOOKS

1.	Biostatistics for the Biological and Health Sciences, 2nd edition by Marc M. Triola, Mario F. Triola, Jason Roy, Pearson publishers, 2017
2.	Rosner B. Fundamentals of Biostatistics, 8th ed. Cengage Learning, Boston, MA, 2016

Online courses

1.	Online course Introduction to Applied Biostatistics: Statistics for Medical Research edX
2.	Introduction to Biostatistics - Course - Swayam

E-Books:

1. Books: Biostatistics: New CD-ROM for self-learning – WHO

List of Experiments:

1. Introduction to Biostatistics:
   - Conduct a study to determine the accuracy of a diagnostic test.

2. Descriptive Statistics:
   - Create a frequency distribution of patient ages.
   - Calculate the mean, median, and mode of patient blood pressure readings.
   - Determine the standard deviation of patient cholesterol levels.
3. Basic Probability Concepts:
   - Calculate the probability of a patient being diagnosed with a particular disease.
   - Determine the odds of a patient being cured of a particular disease.
   - Compute the expected value of a patient's treatment costs.
4. Probability Distributions:
   - Use the binomial distribution to calculate the probability of a patient having a successful outcome after a certain number of treatments.
   - Use the Poisson distribution to calculate the probability of a patient experiencing a certain number of side effects from a particular medication.

- Use the normal distribution to calculate the probability of a patient's blood pressure reading falling within a certain range.

5. Hypothesis Testing:
- Conduct a hypothesis test to determine if there is a significant difference between the mean blood pressure readings of two groups of patients.
- Conduct a hypothesis test to determine if there is a significant difference in the proportion of patients who are cured of a particular disease after two different treatment regimens.
- Determine the power of a hypothesis test to detect a difference in the mean blood pressure readings of two groups of patients.
- Use correlation to determine if there is a relationship between patient satisfaction with their healthcare providers and their overall health status.

Choice of Module: Module 1 and Module 3

Semester	**VI**				
COURSE TITLE	**Computer Vision (EXCEPT MD)**				
COURSE CODE	**22MD6OE1CV**	**Credits**	**3**	**L-T-P**	**3:0:0**
Total Hours of Pedagogy	**40**				
Pre-Requisites: Mathematics Fundamentals, Logical thinking for programming.					

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

CO1	Apply the basic knowledge, theories of mathematics in the analysis of image processing and computer vision algorithms.
CO2	Implement basic and advanced image processing techniques.
CO3	Analyse and implement Model fitting and Deep learning techniques
CO4	Understand 3D image reconstruction techniques.
CO5	Address complex problems , implement algorithms using modern tools ,present, document and submit the report .

CO-PO-PSO-Mapping:-

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3													
CO2				3											
CO3			3	3											
CO4		3													

CO5			3						2	2		2			3
Avg.	**3**	**3**	**3**	**3**					**2**	**2**		**2**			**3**

	Hours
MODULE 1	8
Image Representation and Properties: Introduction - Image Representation - Image Digitization - Digital Image Properties – Discrete Fourier Transform - Image Pre-Processing in Spatial and Frequency Domain: Pixel Brightness Transformation - Geometric Transformations - Local Pre-processing Introduction to computer vision: A brief history, Book overview, Image formation Geometric primitives and transformations , Photometric image formation , The digital camera	
MODULE 2	8
Image processing: Point operators, Linear filtering Non-linear filtering Fourier transforms Pyramids and wavelets Geometric transformations. - Image Smoothing – Edge Detectors - Corner Detectors - Image Restoration. Image Segmentation: Thresholding – Edge- Based Segmentation – Region Based Segmentation, Mean shift segmentation. Model fitting and optimization Scattered data interpolation , Variational methods and regularization , Markov random fields. Deep learning: Supervised learning , Unsupervised learning , Deep neural networks, Convolutional networks , More complex models.	
MODULE 3	8
Image Recognition: Instance recognition, Image classification ,Object detection, Semantic segmentation, Video understanding, Vision and language ,Feature detection and matching ,Points and patches , Edges and contours , Contour tracking , Lines and vanishing points, Segmentation. Image alignment and stitching: Pairwise alignment, Image stitching , Global alignment, Compositing Motion estimation: Translational alignment , Parametric motion , Optical flow, Layered motion.	
MODULE 4	8
Depth estimation: Epipolar geometry, Sparse correspondence, Dense correspondence, Local methods, Global optimization, Deep neural networks, multi-view stereo, Monocular depth estimation	
MODULE 5	8
3D reconstruction : Shape from X 3D scanning , Surface representations, Point-based representations. Volumetric representations, Model-based reconstruction, Recovering texture maps and albedos Image-based rendering : View interpolation, Layered depth images, Light fields and Lumigraphs ,Environment mattes ,Video-based rendering, Neural rendering	

TEXT BOOKS

1.	Richard Szeliski, Computer Vision: Algorithms and Applications, Springer- Texts in Computer Science, Second Edition, 2022.
2.	Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.

REFERENCE BOOKS		
1.	Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.	
2.	Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006	
3.	R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992.	
Online courses		
1.	**https://www.coursera.org**	
2.	**https://www.udemy.com**	
3.	**http://www.cse.iitm.ac.in/~vplab/computer_vision.html**	
E-Books:		
1.	Computer Vision: Algorithms and Applications Author(s) Richard Szeliski Publisher: Springer; 2nd Edition (January 5, 2022); eBook (Final Draft, September 30, 2021)	
2.	Title: Programming Computer Vision with Python: Tools and Algorithms for Analyzing Images Author(s) Jan Erik Solem Publisher: O'Reilly Media, 1 edition (June 29, 2012);	
Choice of Module: Module 2 and Module 3		

Semester	**VI**				
COURSE TITLE	**Wearable Sensors**				
COURSE CODE	**22MD6OE1WS**	**Credits**		**L-T-P**	**3-0-0**
Total Hours of Pedagogy	**40**				
Pre-Requisites: Basic knowledge of Sensors and Electronics					

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

CO1	Apply the knowledge of science, engineering and measurement fundamentals to develop wearable sensors for healthcare purposes.

CO2	Analyze the sensor performances in wearable applications, including body area networks and wireless health platforms
CO3	Design wearable electronic systems for medical diagnosis.

CO-PO-PSO-Mapping:-

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3												3		
CO2		3											3		
CO3			3										3		
Avg.	**3**	**3**	**3**	**3**									**3**		

MODULE 1	
Introduction to Wearable sensors: Physical and Biophysical parameters measured. Block diagram of wireless physiological monitoring system. Types, Characteristics and Working principles of wearable sensors. Body fluid based wearable sensors. Piezoelectric wearable sensors.	8 Hrs
MODULE 2	
Sensors for Wearable systems:- Introduction, Biochemical sensors, Biomechanical sensors, Physiological Sign Sensors : Respiration Activity, Galvanic Skin Response, Pulse Oximetry, Radiant Thermal Sensors, Biochemical Markers, Gas Sensors, Cardiopulmonary Activity Systems.	9 Hrs
MODULE 3	
Wearable body sensor networks (WBSN): Generalized system architecture, System Architecture and Signal Processing Flow. Security requirements in a WBSN, Threats and attacks, Possible solutions for security and privacy in WSBN.	8 Hrs
MODULE 4	
Design of Wireless Health Platforms: System Architecture Requirements for Wireless Health Platforms, System Design. MicroLEAP: A Wireless Health Platform with Integrated Energy Accounting.	7Hrs
MODULE 5	
Wearable Electronic Systems: Applications to Medical Diagnostics: Historical perspective, Present and Possible Clinical Applications for monitoring : Holter-Type, Post-Intervention, On-demand, Emergency/Disaster. Sensing constraints and possibilities. Smart garments.	7 Hrs

TEXT BOOKS	
1	Annalisa Bonfiglio, Danilo De Rossi, Editors, Wearable Monitoring systems, Springer, 2011

2	Subhas Chandra Mukhopadhyaay and Tarikul Islam, Wearable Sensors, IOP publishing, 2017
REFERENCE BOOKS	
1.	Edward Sazonov, Wearable Sensors: Fundamentals, Implementation and Applications, 2nd edition , Academic Press, 2020
2.	Nilanjan Dey , Amira S. Ashour Simon James Fong, Editors, Wearable and Implantable Medical Devices, Academic press
Online courses	
1.	https://www.udemy.com/course/wearable-technology-a-complete-primer-on-wearables/
2.	https://www.edx.org/learn/iot-internet-of-things
E-Books:	
1.	https://www.intechopen.com/books/wearable-technologies/advances-in-wearable-sensing-technologies-and-their-impact-for-personalized-and-preventive-medicine
2.	https://www.sciencedirect.com/book/9780124186620/wearable-sensors
Choice of Module: Module 1 and Module 2	

Semester	**VI**				
COURSE TITLE	**Ergonomics**				
COURSE CODE	**22MD6OE1ER**	**Credits**	**3**	**L-T-P**	**3:0:0**
Total Hours of Pedagogy	**40 Hrs.**				
Pre-Requisites: Basic Engineering Science					

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

CO1	Apply the knowledge of mathematics, science and engineering fundamentals to improve the human machine interaction.
CO2	Formulate, design and analyse the work environment that degrade human–machine performance to arrive at better comfort and productivity.
CO3	Apply reasoning by contextual knowledge to meet the needs of the users to assess health safety and ethical issues.
CO4	Communicate and write report of the case studies for the ergonomically designed models through literature survey as a team work.

CO-PO-PSO-Mapping: -

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3												3		
CO2		3											3		
CO3	3					3		3					3		
CO4		2				2			2	2			2		
Avg.	**3**	**3**				**3**		**3**	**2**	**2**			**3**		

MODULE 1	**8 Hours**
Introduction to Ergonomics: The focus of ergonomics, Ergonomics and its areas of application in the work system, A brief history of ergonomics, Modern ergonomics, Future directions for ergonomics, Anatomy, posture and body mechanics: Anatomy of the spine and pelvis related to posture, Postural stability and postural adaptation, Low back pain, Risk factors for musculoskeletal disorders in the workplace, Behavioural aspects of posture. **Anthropometric principles in workspace and equipment design:** Designing for a population of users, sources of human variability, Anthropometry and its uses in ergonomics, Principles of applied anthropometry in ergonomics, Application of anthropometry in design, Design for everyone, Anthropometry and personal space.	
MODULE 2	**8**
Static work: Design for standing and seated workers: Fundamental aspects of standing and sitting, An ergonomic approach to workstation design, Design for standing workers, Design for seated workers, Work surface design, Visual display units, Guidelines for the design of static work. **Design of repetitive tasks:** Introduction to work-related musculoskeletal disorders, Injuries to the upper body at work, Review of tissue path mechanics and WMSDs, Disorders of the neck, Carpal tunnel syndrome, Tennis elbow (epicondylitis), disorders of the shoulder, Lower limbs, Ergonomic interventions, Trends in work-related musculoskeletal disorders, Design of manual handling tasks topic only.	
MODULE 3	**7**
Work capacity, stress and fatigue: Stress and fatigue, Muscles, Structure, Function and capacity, Physical work capacity, Factors affecting work capacity, Industrial applications of physiology. **Heat, cold and the design of the physical environment:** Fundamentals of human thermoregulation, Measuring the thermal environment, Thermoregulatory mechanisms, Work in hot climates, work in cold climates, Skin temperature, Protection against extreme climates, Comfort and the indoor climate,	

ISO standards.	
MODULE 4	**8**
Vision, light and lighting: Vision and the eye, Measurement of light, lighting design considerations, Visual fatigue, eye strain and near work, Psychological aspects of indoor lighting. **Hearing, sound, noise and vibration:** Terminology, Measurement of sound, Ear protection, Design of the acoustic environment, Industrial noise control, Noise and communication, The auditory environment outdoors, Effects of noise on task performance, Non-auditory effects of noise on health, Noise and satisfaction, Vibration.	
MODULE 5	**9**
Human information processing, skill and performance: A general model of human information processing, Long term and short term memory, multichannel view of attention, ROSPA guidelines for the safe use of mobile communications equipment in vehicles. **Displays, controls and virtual environments:** Principles for the design of visual displays, Auditory displays, Design of controls, Combining displays and controls, Virtual ('synthetic') environments. **Human–computer interaction, memory and language:** Human-centred design processes for interactive systems. Design goals for interactive systems, Guidelines for usability, Human-computer dialogues. **Human–machine interaction, human error and safety:** Human error and equipment design, Mental workload in human machine interaction, Psychological aspects of human error, Characterising human–machine interaction, GOMS, Prevention of error in human–machine interaction, Accidents and safety.	

Text Books:	
1.	Introduction to Ergonomics by R.S. Bridger, Taylor & Francis, eBook Published-26 June 2008.
Reference Books:	
1.	Introduction to Human factors and ergonomics for Engineers, 2nd Edition, Marks Lehto, Steven J Landry. CRC press, Taylor and Francis group, March 2013.
2.	Handbook of Human Factors and Ergonomics, 4th Edition, Gavrial Salvendy, March 2012.
Online Courses:	
1.	https://www.derby.ac.uk/online/ergonomic-courses/ergonomics-human-factors-pg-cert-online/
2.	https://www.engineering.pursue.edu/online/courses/human-factors-engineering/
E-Books:	

1.	https://moodle.ufsc.br/pluginfile.php/748673/mod_resource/content/1/ERGO%20%20Handbook%20of%20Human%20Factors%20and%20Ergonomics%20Methods.pdf
2.	https://doi.org/10.1201/9780203489925
3	https://moodle.ufsc.br/mod/resource/view.php?id=387317https://moodle.ufsc.br/mod/resource/view.php?id=387317
Choice of Module: Module 2 and Module 5	

Semester	**VI**		
Course Title	**Project-2**	**Course Code**	**22MD6PWPJ2**
Credits	**2**	**L-T-P**	**0-0-2**

Course Outcomes	
CO1	Ability to apply knowledge to identify, gather information and analyse to formulate the unmet need and problem definition for project through survey
CO2	Ability to use appropriate tool/tools to implement and demonstrate the project.
CO3	Ability to design and develop sustainable solution/system for the biomedical applications.
CO4	Ability to make effective presentation of the work abiding professional ethics as an individual and a team member.
CO5	Ability to develop systems with scope for enhancement and continue life-long learning.

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	3		3											
CO2					3										
CO3			3			3	3								
CO4								3	3	3	3				
CO5												3			
Avg.	**3**	**3**	**3**	**3**	**3**	3	3	3	**3**	**3**	3	3			

Guidelines for Mini Project–2 (22MD6PWPJ2)
Objective: The objective of this open ended mini project is to let the students apply the knowledge of the engineering subjects into a **real- world situation/problem**.
Guidelines:

1. The project be done in a group of 3 / 4 students.
2. Mini project can be done in the area of medical electronics engineering using the knowledge gain from the courses studied in the lower semesters subjects to be studied during implementation .
3. Mini project must be hardware project with associated software component for it. **(**considering current technology/situation)
4. Each group will be allotted a **Guide**. Students in that group must discuss the project idea with Guide before finalizing it.
5. Each group will present the idea of the project and will submit 1 - 2 page(s) of an **Abstract** of the mini project work.
6. Every week, project group will report progress of the project to allotted Guide.
7. Each group will give progress presentations according to the schedule. .
8. At the end of the project, all groups will submit video of the working model and technical report in the format shared.
9. Final SEE will be conducted for 50 marks.

Semester	**VI**		
Course Title	**Seminar on Hospital Internship**	**Course Code**	**22MD6SRIN2**
Credits	**1**	**L-T-P**	**0-0-1**
Course Outcomes:- At the end of the course, students will have the ability to,			
CO1	**Contextual learning to apply the engineering and medicine knowledge in the design of medical devices, to identify unmet needs and opportunities for innovation**		
CO2	**Identify problems encountered in healthcare through direct immersion in the clinical environment**		
CO3	**Prepare a technical report on clinical immersion and present it in group.**		
CO-PO PSO mapping :			

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010	P011	P012	PS01	PS02	PS03
CO1												3			
CO2									3			3			
CO3									3	3					
Avg.									3	3		3			

Guidelines	
1. Clinical Immersion/ Hospital Internship course provides a valuable opportunity for students to observe and interface with clinicians in their work environment to better enable them to methodically identify opportunities and requirements, while avoiding the product design gap, resulting from a failure to fully understand the customer's needs. Immersion experiences are important in permitting students to experience user-centered design 2. Clinical Immersion through Hospital Visit offered to provide exposure to the clinical environment, including process flow, workarounds, and a first-hand understanding of where and how medical devices are used. The primary learning objective is to formalize a methodical approach to needs assessment based on user-centered design. Upon completion of the Bioengineering Clinical Immersion program, students are well prepared for the design and development of medical devices conceived from validated end-user needs. 3. Students will have to visit various departments in the hospital for 2- 4 weeks to get exposure about medical instruments used in hospital, physiological data acquisition. Students are expected to discuss with doctors/ experts to understand unmet need. This in term will be useful for Mini Project/ Major Project work. 4. Students will give presentation on Hospital visit experience and prepare the in detail report on their hospital visit experience and Need identification. 5. Students will be evaluated by the Committee in the department. Based on presentation and report submission CIE marks will be given. **6.** For SEE, students will give presentation in presence of external examiner and marks will be given based on the Presentation and Report prepared**.**	

Semester	**VI**				
COURSE TITLE	**IPR and Cyber laws**				
COURSE CODE	**22ES6HSIPL**	**Credits**		**L-T-P**	**2-0-0**
Total Hours of Pedagogy	**25**				
Pre-Requisites: Nil					

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

CO1	Ability to understand and commit to professional ethics and responsibilities to obtain Intellectual property Rights like Patents, Copyright & Trademarks
CO2	Understand the impact of Patents, Copyright & Trademarks and demonstrate the knowledge of Cyber Law for the societal and environmental context
CO3	Ability to understand and commit to professional ethics and responsibilities to obtain Intellectual property Rights like Patents, Copyright & Trademarks
CO4	Understand the impact of Patents, Copyright & Trademarks and demonstrate the knowledge of Cyber Law for the societal and environmental context

CO-PO-PSO-Mapping: -

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1								3							
CO2							3								
CO3						3									
CO4									3	3					
Avg.						3	3	3	3	3					

	Hours
MODULE 1	5
Basic principles of IP laws & Patents: Introduction, Concept of property, Constitutional aspects of IP, Evolution of the patent system in UK, US and India, Basis for protection, Origin and meaning of the term patent, Objective of a patent law, principles underlying the patent law in India, the legislative provisions regulating patents, Non – patentable inventions.	
MODULE 2	6
Procedure for obtaining patent: Submission of application, Filing provisional and complete specification, Examination of the application, advertisement of the acceptance, opposition, Grant and sealing of patent, Term of the patent, compulsory license. Provisional and complete specification: Definition of Specification, Kinds of specification, provisional specification, complete specification, Claims, Conditions for amendment. Rights conferred on a patentee: Patent rights, Exception and limitations, Duties of a Patentee. Transfer of patent: Forms of transfer of Patent rights, Assignment, kinds of assignment, License, kinds of license, Rights	
MODULE 3	6

Copy Right: Meaning and characteristics of copy right, Indian copy right law, requirement of copy right, Illustrations copy right in literary work, Musical work, Artistic work, work of architecture, Cinematograph film, sound recording. Author and Ownership of copy right: Ownership of copy right, Contract of service, Contract for service, rights conferred by copy right, terms of copy right, license of copy right. Infringement of copy right: Acts which constitute infringement, general principle, direct and indirect evidence of copying, Acts not constituting infringements, Infringements in literary, dramatic and musical works, Remedies against infringement of copy right, Case studies Trade Marks: Introduction, Statutory authorities, procedure of registration of trademarks, rights conferred by registration of trademarks, licensing in trade mark, infringement of trade mark and action against infringement	
MODULE 4	4
Cyber Law: An introduction, Definition, why cyber law in India, Evolving cyber law practices- for corporates, privacy in Indian cyber space. Terrorism & Cyber Crime. Cyber theft and Indian telegraph act, Cyber Stalking,	
MODULE 5	4
Indian Cyber law: Protecting Indian children online, POCSO act, Spam, contempt in cyber space, Indian consumers & cyber space, E-courts of India, Emerging trends in cyber law	

TEXT BOOKS	
1	Dr. T Ramakrishna, "Basic principles and acquisition of Intellectual Property Rights", CIPRA, NSLIU -2005.
2	Dr.B.L.Wadehhra, " Intellectual Property Law Handbook", Universal Law Publishing Co. Ltd., 2002.
3	Cyberlaw-The Indian perspective by Pavan Duggal, 2009 Edition.
REFERENCE BOOKS	
1.	Dr. T Ramakrishna, "Ownership and Enforcement of Intellectual Property Rights", CIPRA, NSLIU -2005
2.	"Intellectual Property Law (Bare Act with short comments)",Universal Law Publishing Co. Ltd. 2007.
3.	"The Trade marks Act 1999 (Bare Act with short comments)", Universal Law Publishing Co. Ltd., 2005.
Module Choice:	

Semester	**VI**		
Course Title	**Personality Development and Communication**	**Course Code**	**22MD6NCPDC**
Credits	**NCMC**	**L-T-P**	**0-0-0**

This courses deals with the various aspects of developing a balanced personality to be a successful and competitive team player, in the context of the Engineers required to be more dynamic, quick and resilient.

This course will make the students to

- Comprehend that Success is relative
- Learn the of good and great engineers
- Know the requirements in the context of global engineering challenges
- Recognize the types of personality traits
- Know the tips to improve his/her personality
- Understand the kinds of aptitude tests

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VII Semester Syllabus

Semester	VII				
COURSE TITLE	Biology for Medical Electronics Engineers				
COURSE CODE	22MD7BSBME	Credits	1	L-T-P	0:1:0
Total Hours of Pedagogy	15				
Pre-Requisites: Basics of biology					

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

CO1	Apply fundamental biological concepts and principles to engineering problems, demonstrating an understanding of the interplay between biology and engineering disciplines.
CO2	Gain proficiency in conducting virtual laboratory experiments in biology, utilizing relevant software tools and virtual lab simulations to perform experiments, collect data, analyze results, and draw scientific conclusions.
CO3	Develop critical thinking and problem-solving skills by applying scientific methods to investigate biological phenomena, make predictions, and propose engineering solutions that integrate biological principles and technologies.

CO-PO-PSO-Mapping:-

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2		3											3		
CO3			3										3		
Avg.	**3**	**3**	**3**										**3**		

MODULE 1	4Hrs
Virtual Lab Experiments: Cell Biology 1. Collection of Serum from Blood 2. Blood Grouping Experiment	
MODULE 2	**4Hrs**
Virtual Lab Experiments: Immunology 1. Antibody Labelling with HRP 2. Extraction of IgG Antibodies from Immunized Hen Egg	

MODULE 3	2Hrs
Virtual Lab Experiments: Microbiology 1. Bacterial Growth Curve **2.** Litmus Milk Test	
MODULE 4	**2Hrs**
Virtual Lab Experiments: Molecular biology 1. Agarose Gel Electrophoresis (AGE) 2. Polymerase Chain Reaction (PCR)	
MODULE 5	**3Hrs**
Virtual Lab Experiments: Neurophysiology 1. Modeling resting potentials and action potentials in Neurons 2. Simple Neuron Model - the HH neuron	

TEXT BOOKS	
1.	Arthur T. Johnson, Biology for Engineers, Second Edition, CRC Press 2019
2.	Condon, Anne et.al. Algorithmic Bioprocesses. Berlin: Springer, 2009.
REFERENCE BOOKS	
1.	**Molecular Biology: A Project Approach by Susan J. Karcher**
2.	**Cappuccino G. James, Sherman Natalie, Microbiology A laboratory manual, seventh edition, Pearson Education**
Online courses	
1.	https://www.classcentral.com/course/swayam-biology-for-engineers-and-other-non-biologists-13917
2.	https://onlinecourses.nptel.ac.in/noc19_ge31/preview
E-Books:	
1.	Biology for engineers byArthur T. Johnson (Author) eBook CRC Press, Taylor & Francis Group
2.	Waite, Gabi Nindle, and Lee Waite R, eds. 2007. Applied Cell and Molecular Biology for Engineers. 1st ed. New York: .

List of Experiments: ** Mentioned in each Unit**.**

Evaluation Criteria:

- Experiment Conduction &Viva – 30 Marks
- CIE Test 1: MCQ – 20 marks
- Total CIE: 50 Marks.
- SEE: MCQ – 50 marks

Semester	**VII**		
Course Title	**Medical Device Development**	**Course Code**	**22MD7PCMDD**
Credits	**4**	**L-T-P**	**3-1-0**
Pre Requisites	Analog Electronics Circuits, Digital Integrated Circuits Human Physiology and Medical Physics		

Course Outcomes: At the end of the course the students will have an,

CO1	Identify and analyze unmet clinical need and its requirements to solve the identified need.
CO2	Search, analyze and document clinical practice, engineering science and relevant literature in order to determine the need for further research and development in a chosen clinical area.
CO3	develop a sustainable business plan, including market overview, regulation strategies for health & safety of individuals and intellectual property (IP) strategies
CO4	Understand medical device design engineering and manufacturing process by avoiding common quality pitfalls in turn learning project management (PERT, Critical Path, etc).
CO5	develop a virtual product of given medical device comprising of requirement analysis, Risk Analysis and management, High level design, usability analysis, verification and validation and present the findings in a team.

CO-PO PSO Mapping:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	2													
CO2			3	2								2	2	3	
CO3				3	3										
CO4							3	3						3	
CO5				3					3	3	3	3			
Avg.	**3**	**2**	**3**	**3**	**3**		**3**	**3**	**3**	**3**	3	3	**2**	3	

	Hours
MODULE 1	**8**
MedTech Innovation: Introduction, the status of bio-innovation in India, DALY, MedTech Innovation, New medical device steps, Common Myths, Bio design process, clinical immersion, need filtration, Need Specification document, case studies, Market Segmentation, Concept Generation and Selection, Perfint Maximo Example.	
MODULE 2	8
Product Requirement: Classification of Medical Device (FDA/CE/CDSCO), Requirement Analysis: Functional, Safety, Usability, User interface, Clinical Workflow, Internal Interface, Working environment, Infrastructure, Safety, Adaptability, Availability, User training, Labelling, Operating cost, Disposable, Design Input, ISO 13485.	

MODULE 3		8
Design Engineering: Clinical Workflow, Design for Manufacturing, Design for Serviceability, FMEA, Economy of Scale, Standards in Medtech, Safety and Risk Management, Case studies.		
MODULE 4		8
Human Factor Engineering: HE75, Common UI and UA issues, Economy of Scale, Product Requirements, Design engineering, Practical Development process, Importance of verification and review, Iterative development, Design and development plan, Design Output, Design Process, Design Verification, Design Validation, Design Review, Review versus verification versus validation, Design Transfer, Functional Block Diagram, High-Level Design, Signal flow path / Signal Characteristics.		
MODULE 5		**7**
Project Management and sustainability: Activity Planning - Objectives, Defining Activities, Project Plan (Gantt Chart), Network Planning models -Critical path management (CPM), Precedence Network, Nodes, Activity network, Forward Pass, Backward Pass, Float, Critical Path and its importance Sustainability: Need, external push towards sustainability, hospital role, barriers, making sustainable device, examples.		
TEXT BOOKS		
1	Biodesign: The Process of Innovating Medical Technologies, by Paul Yock, Stefanos A. Zenios, and Todd J. Brinton, Cambridge University Press, 2nd edition, 2015.	
2	Inventing Medical Devices: A Perspective from India, by Jagdish Chaturvedi, Notion Press, 2017.	
REFERENCE BOOKS		
1	The Medical Device R&D Handbook, by Theodore R. Kucklick, Second Edition, CRC Press, 2012.	

Semester	**VII**				
COURSE TITLE	**Biomechanics and Rehabilitation Engineering**				
COURSE CODE	**22MD7PE3BR**	**Credits**	**3**	**L-T-P**	**2:1:0**
Total Hours of Pedagogy	**40**				
Pre-Requisites: Basics of Anatomy and Physics of flow properties					

Course Outcomes: At the end of the course the students will have an,

CO1	Ability to apply knowledge of mathematics, science and engineering to understand the fundamentals of the flow properties of the blood.
CO2	Ability to analyse the dynamics and properties of viscoelastic materials in the body.
CO3	Ability to apply the principles of biomechanics to a range of Rehabilitation strategies and problem solving.
CO4	Apply appropriate techniques using Modern tool for modelling to complex engineering activities ,document and present the report.
CO5	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.

CO-PO-PSO-Mapping:-

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3														
CO2		3													
CO3			3	3											
CO4					3				2	2		2		3	2
CO5						3									
Avg.	**3**	**3**	**3**	**3**	**3**	**3**			**2**	**2**		**2**		**3**	**2**

	Hours
MODULE 1	8
Introduction To Biomechanics –Principles of Biomechanics, Stress ,Strain and Strain Rate,The Non viscous Fluid, Newtonian Viscous Fluid, The Hookean Elastic Solid, Viscoelasticity, Response of a Viscoelastic Body to Harmonic Excitation, Use Of Viscoelastic Models The Flow Properties of Blood-Blood rheology, the constitutive equation of blood based on viscometric data and casson's equation, Laminar flow of blood in tube, blood with viscosity described by Casson's equation. Case studies and Problems	
MODULE 2	8
Bio viscoelastic fluids: Introduction, small deformation experiments, mucus from the respiratory tract, saliva, cervical mucus and semen, synovial fluid, flow properties of synovial fluid,Bio viscoelastic solids: Introduction, some elastic materials-actin, elastin, resilin and abduction, fibers, collagen, Quasi-linear viscoelasticity of soft tissues, the concept of pseudo-elasticity.	
MODULE 3	8
Sports and Fitness Kinesiology: Muscle Action in Sport and Exercise Neural Contributions to Changes in Muscle Strength - Mechanical Properties and Performance in Skeletal Muscles - Muscle-Tendon Architecture and Athletic Performance - Eccentric **Muscle Action in Sport and Exercise** - Stretch–Shortening Cycle of Muscle Function -Biomechanical Foundations of Strength and Power Training Locomotion - Kinesiological view Factors Affecting Preferred Rates of Movement in Cyclic Activities The Dynamics of Running - Resistive Forces in Swimming - Propulsive Forces in Swimming -Performance-Determining Factors in Speed Skating - Cross-Country Skiing: Technique, Equipment and Environmental Factors Affecting Performance. Gait and movement analysis**.**	
UNIT 4	8
Introduction to Rehabilitation and Rehabilitation Team: What is Rehabilitation? Epidemiology of Rehabilitation, Health, Levels of Prevention, Preventive Rehabilitation, Diagnosis of Disability, Functional, Diagnosis, Importance of Physiatry in Functional Diagnosis, Impairment Disability Handicap, Primary and Secondary disabilities, Effects of Prolonged inactivity and Bed rest on body system. Rehabilitation Team: classification of members, The Role of members, The Role of Physiatrist, Occupational therapist, Recreation therapist, Prosthetist- Orthotist, speech pathologist, Rehabilitation nurse, social worker, Corrective Therapist, Psychologist, Music therapist, Dance therapist and Biomedical Engineer.	

MODULE 5	8
Therapeutic Exercise Technique: Co-ordination exercises, Freckles exercises, Gait analyses-pathological Gaits, Gait Training, Relaxation Exercises- Methods for training Relaxation, Strengthening exercises- strength training, Types of contraction, Mobilization exercises, Endurance Exercises, Principles in management of communication Impairment – introduction to communication, Aphasia, Types of Aphasia, Treatment of aphasic patient, Augmentative communication-general form of communication, types of visual aids, Hearing aids, Types of conventional hearing aid, writing aids.	

TEXT BOOKS	
1. **1**	Biomechanics- Mechanical Properties of Living tissues -Y.C.Fung -Second Edition-Springer Verlag.
2. 2	Text book of Rehabilitation- S Sunder- 3rd Edition-Jaypee Brothers Medical Publishers(P) Ltd. New Delhi
REFERENCE BOOKS	
1.	Biomechanics principles and applications by Schneck and Bronzino, CRCPress, 2003
2.	Physical Rehabilitation by Susan B O'Sullivan, Thomas J Schmitz. 5th Edition
Online courses	
1.	Visual3D 3D Biomechanics Adwww.c-motion.com/
2.	https://rerc-aac.psu.edu/dissemination/webcasts/
3.	https://ep.jhu.edu/programs-and-courses/585.414-rehabilitation-engineering
E-Books:	
1.	http://www.profedf.ufpr.br/rodackibiomecanica_arquivos/Books/Introduction%20to%20Sports%20Biomechanics.pdf
2.	http://www.profedf.ufpr.br/rodackibiomecanica_arquivos/Books/Duane%20Knudson-%20Fundamentals%20of%20Biomechanics%202ed.pdf
Choice of Module: Module 3 and Module 4	

Semester	VII			
COURSE TITLE	ADVANCED IMAGE PROCESSING			
COURSE CODE	22MD7PE3IP	L-T-P	2:1:0	3
Pre-Requisites: Digital Image Processing				

COURSE OUTCOMES:

CO1	Apply the knowledge of Mathematics and Engineering to process and analyze the images.
CO2	Formulate and Use Morphological operations for image enhancement and analysis.
CO3	Ability to implement the processes to detect and recognize an object in the images to provide the conclusion for the problem.
CO4	An ability to design and apply transforms to compress and enhance the quality of images to enhance the accuracy and the efficiency.
CO5	Ability to use current techniques and modern tools to improve the image quality and analysis, document and present the same.

CO-PO-PSO-Mapping:-

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3														
CO2		3													
CO3				3										3	
CO4			3												3
CO5					3				3	3					
Avg.		**3**	**3**	**3**	**3**				**3**	**3**				3	3

MODULE 1	8Hrs
MORPHOLOGICAL IMAGE PROCESSING: Preliminaries, Erosion and Dilation, Erosion, Dilation, Duality, Opening and Closing, The Hit-or-Miss Transformation, Basic Morphological Algorithms, Boundary Extraction, Hole Filling, Extraction of Connected Components, Convex Hull, Thinning, Thickening, Skeletons, Pruning, Morphological Reconstruction. Gray-Scale Morphology, Erosion and Dilation, Opening and Closing, Basic Gray-Scale Morphological Algorithms, Gray-Scale Morphological Reconstruction.	
MODULE 2	8 Hrs

IMAGE SEGMENTATION: Fundamentals, Point, Line, and Edge Detection, Background, Detection of Isolated Points, Line Detection, Edge Models, Basic Edge Detection, More Advanced Techniques for Edge Detection, Edge Linking and Boundary Detection, Thresholding, Foundation, Basic Global Thresholding, Optimum Global Thresholding Using Otsu's Method, Using Images Smoothing to Improve Global Thresholding, Using Edges to Improve Global Thresholding, Multiple Thresholds, Variable Thresholding, Multivariable Thresholding, Region-Based Segmentation, Region Growing, Region Splitting and Merging, Segmentation Using Morphological watersheds, Background, Dam Construction, watershed segmentation Algorithm		
MODULE 3		8Hrs
REPRESENTATION AND DESCRIPTION: Representation, Boundary (Border) Following, Chain Codes, Polygonal Approximations Using Minimum-Perimeter Polygons, Other Polygonal Approximation Approaches, Signatures, Boundary Segments, Skeletons, Boundary Descriptors, Shape Numbers, Fourier Descriptors, Statistical Moments, Regional Descriptors, Topological Descriptors, Texture, Moment Invariants, Use of Principal Components for Description.		
MODULE 4		8Hrs
OBJECT RECOGNITION: Patterns and Pattern Classes, Recognition Based on Decision-Theoretic Methods, Matching, Optimum Statistical Classifiers, Neural Networks, Structural Methods, Matching Shape Numbers, String Matching.		
MODULE 5		8Hrs
WAVELETS AND MULTIRESOLUTION PROCESSING: Image Pyramids, Sub band Coding, The Haar Transform, Multi resolution Expansions, Series Expansions, Scaling Functions, Wavelet Functions, Wavelet Transforms in One Dimension, The Wavelet Series Expansions, The Discrete Wavelet Transform, The Continuous Wavelet Transform.		
TEXT BOOKS		
1	Digital Image Processing by Rafael C. Gonzalez & Richard E. Woods, Third Edition. Pearson Education Inc.	
2	Image Processing, Analysis and Machine-Vision by Milan Sonka, Vaclav Hlavac & Roger Boyle, Second Edition.	
REFERENCE BOOKS		
1	Digital Image Processing using MATLAB by Rafael. Gonzalez & Richard E. Woods, Second Edition. Pearson Education Inc.	
2	Digital Image Processing by S Jayakumaran, S Esakkirajan, T Veerakumar, Tata McGraw Hill Education Private Ltd,.	
3	Fundamentals of Digital Image Processing by Anil.K. Jain.	
4	NPTEL Video Lectures	
Choice of Module: Module 2 and Module 5		

Semester	VII		
Course Title	Medical informatics	Course Code	22MD7OE2MI
Credits	3	L-T-P	3-0-0
Pre Requisites: DBMS,biomedical concepts, Management principles			
Course Outcomes:			
CO1	Explore how technology can be used to improve health care delivery in organizations		
CO2	Analyze the principles of health informatics		
CO3	Develop basic skills in using health informatics principles to improve practice		
CO4	Acquire a conceptual and theoretical framework of the design, development, and implementation of health information systems.		
CO5	Programming skills in Java and script languages through implementation on the application on Medical informatics		

CO-PO/PSO mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3					1							3		
CO2		3	2										3		
CO3		3	2			1	1						3		
CO4		3				1	1						3		
CO5					2				2	2			3		
Avg	3		2		2	1	1		2	2			3		

MODULE 1	Hrs
INTRODUCTION Historical highlights and Evolution of Health informatics, Hospital Information System – its characteristics and functional online and offline modules, Health Informatics, Bioinformatics, Medical Informatics, Clinical Informatics, imaging Informatics, Nursing Informatics, Public Health Informatics, e – health services, Evidence Based Medicine, Bioethics, Virtual Hospital, Consumer Health Informatics and Healthcare Data Analytics.	8
MODULE 2	
ELECTRONICS PATIENT RECORDS AND STANDARDS Electronic Patient Record, Medical data formats, – Medical Standards and Organizations – HL7 – DICOM - IRMA - LOINC - PACS - Medical Standards for Vocabulary - ICD 10, DRGs, MeSH, UMLS, SNOMED – JCAHO – HIPAA.	**8**
MODULE 3	
BIOINFORMATICS AND TECHNOLOGIES Bio-information technologies, Semantic web and Bioinformatics, Genome projects - Education and Training - Nano technology in Healthcare - Nanomedicine, Nanopharma,	8

CNT based Nano sensor, BioCom chip, Medical Nanorobo - Virtual		
MODULE 4		
JAVA PROGRAMMING Design and Development of Hospital Information Systems – Developing front-end, back-end and Client – Server interface programs in Java Environment – SQL.		8
MODULE 5		
INTERNET AND WEB Medical Networks - Java script programming - Web Design and programming - Design of Web portal services in medicine		8
Text Books		
1	Robert E Hoyt, Ann Yoshihashi, Health Informatics: Practical Guide for Healthcare and Information Technology Professionals, 6th Edition, lulu.com, 2014.	
2	Mohan Bansal M S, Medical Informatics, Tata McGraw Hill Publishing Company, New Delhi, 2005.	
3	Herbert Schildt, The Complete Reference – JAVA, Tata McGraw Hill Publishing Company, New Delhi, 2005	
Reference Books:		
1	Yi-Ping Phoebe, Bioinformatics Technologies, Springer International, New Delhi, 2007.	
2	Orpita Bosu, Bioinformatics – Databases, Tools and Algorithms, Oxford University Press, 2007	
3	H M Dietel, Internet and World Wide Web, AB Goldberg publishers, New Delhi, 2007	
Online courses:		
1	www.bu.edu › BU Online Home › Programs	
2	study.com/.../Online_Graduate_Courses_and_Classes_in_Healthcare_Inf...	
3	https://www.umb.edu/academics/caps/certificates/healthcare_informatics	
E-Books:		
1	www.springer.com/in/book/9782817804774	
2	ebooks.himss.org/product/medical-informatics-executive-primer	
Choice of Module: Module 3 and Module 5		

Semester	VII		
Course Title	Embedded System Design	Course Code	22MD7OE2ES
Credits	3	L-T-P	3-0-0

Pre Requisites: Knowledge of Microcontrollers, basic electronic hardware and programming

Course Outcomes:- At the end of the course, students will have the ability to

CO1	Apply the knowledge of electronic engineering fundamentals to design, evaluate and analyze the performance of embedded systems.
CO2	Analyze the real-time performance of embedded systems using the first principles of engineering science.
CO3	Design embedded system components for the given specifications of complex engineering problems.

CO-PO PSO mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3			3									3		
CO2		3											3		
CO3			3										3		
Avg.	**3**	**3**	**3**	**3**									**3**		

MODULE 1	
Introductory Concepts:- Embedding Computers, Embedding computer systems - Characteristics, quality attributes , Requirements and design Challenges . The embedded system design process. Platform-based design methodology, Hardware in the loop, Sensors for the real world, Sample and hold circuits, ADCs – Successive approximation, Pipelined. Quantization noise. Embedded Processing: Energy, Code-size and execution-time efficiency.	**8 Hrs**
MODULE 2	
Embedded Hardware Components: - CPU : Microcontrollers, Multicore, GPUs, SoCs, Reconfigurable logic. Memories-Conflicting goals, Hierarchies, Reference files, Caches. Supervisor mode, Exceptions and Traps. Communication: Requirements, Electrical robustness, Guaranteed Real Time behavior, Examples of I2C. Securing hardware.	**7 Hrs**
MODULE 3	

Design of Embedded Firmware:- Design approaches, Development languages and design – Low and high level language based approaches, Mixing assembly with high level. RTOS: RT Kernel, Tasks, Processes and threads and thread standards, Multitasking, - types, Task communication and synchronization. Interprocess Communication mechanisms.		**10 Hrs**
MODULE 4		
Design of Embedded System Software: - General requirements, Task communication and synchronization, Resource access protocols, Priority – Inversion, inheritance, and ceiling protocol. Stack resource policy, Enterprise real-time kernel – ERIKA. Embedded Linux-overview. Selection of RTOS. Software performance optimization.		**8 Hrs**
MODULE 5		
Evaluation and Validation: - Scope, Multi-objective Optimization, Relevant objectives. Performance evaluation – Early phases, WCET estimation, Real Time Calculus. Quality metrics: Approximate computing, simple criteria of quality, criteria for data analysis, worst case energy consumption. Dependability and safety analysis.		**7 Hrs**
Text Books		
1	Peter Marwedel, Embedded System Design, 3rd edition, 2018, Springer	
2	Shibu K.V, Introduction to Embedded systems, 2nd edition, 2017, McGraw Hill.	
Reference Books:		
1.	Wayne Wolf, Computers as Components, 2nd edition, Morhan Kaufmann, 2011, Elsevier.	
2.	Jack Ganssle, The art of designing embedded systems, 2nd edition, 2008, Newness, Elsevier,	
Online courses:		
1.	https://www.coursera.org/learn/embedded-software-hardware	
2.	https://onlinecourses.nptel.ac.in/noc20_ee98/preview	
3.	https://www.edx.org/course/embedded-systems-shape-the-world-multi-threaded-in	
E-Books:		
1.	http://users.ece.utexas.edu/~valvano/Volume1/E-Book/	
2.	https://freecomputerbooks.com/Embedded-System-Design.html	
Choice of Module: Module 3 and Module 4		

Semester	VII				
COURSE TITLE	DATA SCIENCE FOR ENGINEERING APPLICATIONS				
COURSE CODE	22MD7OE2DS	Credits	3	L-T-P	3:0:0
Total Hours of Pedagogy	40				
Pre-Requisites: Signal processing, Engineering Mathematics					

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

CO1	Apply the knowledge of descriptive data analytics and related techniques to process the data.
CO2	Develop programs for the visualization of the data for an application
CO3	Analyze and build predictive models from data
CO4	Engage students in individual or in a team to conduct a open ended experiment and document the same.

CO-PO-PSO-Mapping:-

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3												3		
CO2		3											3		
CO3			3										3		
CO4			3		3				2	2			3		
Avg.	**3**	**3**	**3**		**3**				**2**	**2**			**3**		

MODULE1	8
BASIC CONCEPTS: Introduction to Data Science, Data analytics life cycle overview, discovery, data preparation, Model planning, Model building, Communicate results, Operationalize.	
MODULE 2	8
DATA ANALYTICS USING R: Introduction to R, R graphical user interfaces, Data import and Export, Attribute and Data types, Descriptive statistics, Exploratory data analysis, visualization before analysis, dirty data, visualizing single variable, examining multiple variable, data exploration vs. presentation.	
MODULE 3	8

STATISTICAL METHOD FOR EVALUATION: Hypothesis testing, Difference of Means, Type I and II errors, Power and sample size, Anova techniques.	
MODULE 4	8
ANALYTICAL METHODS: Regression, Linear regression, logistic regression, reasons to choose and cautions, Additional regression models, Classification- Decision tree, Naïve Bayes, Diagnostics of classifiers, Clustering- K-means.	
MODULE 5	8
DELIVERING RESULTS: Documentation and deployment, producing effective presentation, Introduction to graphical analysis, plot () function, displaying multivariate data, matrix plot, multiple plots in a window, exporting graph, graphic parameters, Case study.	

TEXT BOOKS	
1	Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data, EMC Education Sevices 2015
2	Nina Zumel, "Practical Data Science with R" Manning Publications Co 2014.
3	David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications

REFERENCE BOOKS	
1	Eric Pimpler, Data Vizualization and Exploration with R, GeoSpatial Training service, 2017
2	Sanjeev J. Wagh, Manisha S. Bhende, Anuradha D. Thakare, "Fundamentals of Data Science", CRC Press
3	Chirag Shah, "A Hands-On Introduction to Data Science", Cambridge University Press
4	Vineet Raina, Srinath Krishnamurthy, "Building an Effective Data Science Practice: A Framework to Bootstrap and Manage a Successful Data Science Practice", Apress

Online courses	
1	https://onlinecourses.nptel.ac.in/noc21_cs69/preview
2	https://www.coursera.org/professional-certificates/ibm-data-science

E-Books:	
1	https://people.smp.uq.edu.au/DirkKroese/DSML/DSML.pdf
2	http://bedford-computing.co.uk/learning/wp-ontent/uploads/2016/09/introducing-data-science-machine-learning-python.pdf

Choice of Module: Module 2 and Module 4

Semester	VII				
COURSE TITLE	Biomedical Project Management and Finance				
COURSE CODE	22MD7HSBPF	Credits	2	L-T-P	2:0:0
Total Hours of Pedagogy	25				
Pre-Requisites: Personality development course, soft skills					

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

CO1	Apply the knowledge of project management principles to execute the methodologies required for the completion of project.
CO2	Develop ethical principles in Biomedical project planning and execution as a team member to prepare a Project Document.
CO3	Identify and apply financial aspects for project implantation on time.
CO4	Document the project for different case studies in a team and present the same.

CO-PO-PSO-Mapping:-

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	3									3				2
CO2		3	3					2	2		3				2
CO3		3	3						2		3				2
CO4			2		2				2	2	3	2			2
Avg.	**3**	**3**	**3**		**2**			**2**	**2**	**2**	**3**	**2**			**2**

MODULE 1	5
CONCEPTS OF PROJECT MANAGEMENT: Project Leadership and Ethics: Introduction to project leadership, ethics in projects, Multicultural and virtual projects. Concepts of project, Categories of project, Project life cycle phases, Project management concepts, Tools and techniques for project management, The project manager, Basic education for a project manager, Roles and responsibilities of project manager, Project manager as profession, Summary.	
MODULE 2	5
ESTABLISHING THE PROJECT: Scope, Time, Cost and performance goals, Feasibility report, Financing Arrangements, Preparation of cost estimates, Finalization of project implementation schedule, Evaluation of the project profitability, appointing a project manager, Fixing the Zero date, Summary.	
MODULE 3	5
PROJECT LEADERSHIP FOR BIOMEDICAL INDUSTRIES: Introduction- The Challenge, Unique characteristics of Biomedical Products, Biomedical company landscape, Changing process and technology, Standards and Regulations, Global focus, Project management in BMI Companies, Project management solutions, Project organization, New product development, Anatomy of Biomedical Project teams and key aspects, Projectization of work	
MODULE 4	5
MEDICAL DEVICES- COMPONENTS, SYSTEMS AND THEIR INTEGRATION: Changing landscape of the medical device industry, Phase-Gate development model, Medical device system-LVAD system, Typical product lifecycle, Parallel life cycles of devices and components, Medical devices and Product management, Typical invitro diagnostics Product development Process, Interdependent players and the Project Manager, Project Constraints and Mitigated Project Constraints.	
MODULE 5	5
FINANCING OF PROJECTS: Capital structure, Menu of financing, Internal accruals, Equity capital, Preference capital , Debentures (or bonds) , Methods of offering term loans , Working capital advances, Miscellaneous sources , Raising venture capital, Project financing structures, Financial closure , Financial institutions ,Summary.	
TEXT BOOKS	
1 Project Management – S Choudhury, Tata McGRAW Hill Publishing Company Limited	
2 Pharmaceutical and Biomedical Project Management in a Changing Global Environment -Scott D. Babler, Wiley, A John Wiley & Sons, Inc., Publication	
3 Projects- Planning, Analysis , Selection, Financing ,Implementation and Review –Dr. Prasanna Chandra McGRAW Hill Publishing Company Limited	
REFERENCE BOOKS	

1	Fundamentals of Project Management by Dr.Vijay Kanabar	
2	Project Management – David I Cleland – Mcgraw Hill International edition	
3	Project Management – Gopalakrishnan – Mcmillan India Ltd	
4	Project Management – harry – Maylor- Peason Publication	
Online courses		
1	NPTEL lecture on Introduction to project management by prof. Arun Kanda https://www.youtube.com/watch?v=5pwc2DYlKQU	
2	https://www.youtube.com/watch?v=5d16JwWwjKo	
E-Books:		
1	https://searchworks.stanford.edu/view/9651591	
2	https://open.umn.edu/opentextbooks/textbooks/456	
Choice of Module: Module 3 and Module 4		

Semester	**VII**		
Course Title	**Project-3**	**Course Code**	**22MD7PWPJ3**
Credits	**3**	**L-T-P**	**0-0-3**

Course Outcomes	
CO1	Ability to apply knowledge to identify, gather information and analyse to formulate the unmet need and problem definition for project through survey
CO2	Ability to use appropriate tool/tools to implement and demonstrate the project.
CO3	Ability to design and develop sustainable solution/system for the biomedical applications.
CO4	Ability to make effective presentation of the work abiding professional ethics as an individual and a team member.
CO5	Ability to develop systems with scope for enhancement and continue life-long learning.

CO-PO-PSO-Mapping:-

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	3		3											
CO2					3										
CO3			3			3	3								

CO4								3	3	3	3				
CO5												3			
Avg.	**3**	**3**	**3**	**3**	**3**	3	3	3	**3**	**3**	3	3			

Guidelines for Mini Project–3 (22MD7PWPJ3)
Objective: The objective of this open ended mini project is to let the students apply the knowledge of the engineering subjects into a **real- world situation/problem**.
Guidelines:
1. The project be done in a group of 3 / 4 students.
2. Mini project can be done in the area of medical electronics engineering using the knowledge gain from the courses studied in the lower semesters subjects to be studied during implementation .
3. Mini project must be hardware project with associated software component for it. **(**considering current technology/situation)
4. Each group will be allotted a **Guide**. Students in that group must discuss the project idea with Guide before finalizing it.
5. Each group will present the idea of the project and will submit 1 - 2 page(s) of an **Abstract** of the mini project work.
6. Every week, project group will report progress of the project to allotted Guide.
7. Each group will give progress presentations according to the schedule. .
8. At the end of the project, all groups will submit video of the working model and technical report in the format shared
9. Final SEE will be conducted for 50 marks

Semester	VII		
Course Title	MOOC -1	Course Code	22MD7NCMOC
Credits	NCMC	L-T-P	---

Guidelines for MOOC:

1. students will register for the MOOC related to BMSPI or allied areas only
2. The MOOC must be of 4 weeks or 8 weeks duration
3. After completion of the course students will submit certificate
4. Based on the certificate P/NP grade will be given

VIII Semester Syllabus

Semester	**VIII**				
COURSE TITLE	**Biomaterials and Artificial Organs**				
COURSE CODE	**22MD8PE4BA**	**Credits**	**3**	**L-T-P**	**2:1:0**
Total Hours of Pedagogy	**40**				
Pre-Requisites: Engineering Physics, Engineering Chemistry, Biology					

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

CO1	Apply the principles and properties of biomaterials used in medical applications.
CO2	Analyze the properties and select appropriate biomaterials based on their mechanical, chemical, and biological properties.
CO3	Analyze the design and development of artificial organs and the challenges associated with their implementation.
CO4	Apply the knowledge of biomaterials and artificial organs to solve practical problems in the medical field.
CO5	Recognize the ethical, regulatory, and safety considerations related to the use of biomaterials and artificial organs.

CO-PO-PSO-Mapping:-

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												2		
CO2		3											2		
CO3		3											2		
CO4	3								3	3			2		
CO5								3					2		
Avg.	**3**	**3**						**3**	**3**	**3**			**2**		

	Hours
MODULE 1	8 Hrs
Introduction to Biomaterials: Definition, classification, and applications, Physical, mechanical, chemical, and biological properties of biomaterials, Biocompatibility and host response to biomaterials, Surface modification techniques for improving biomaterial performance, Regulatory and ethical considerations in biomaterials research and	

development.	
MODULE 2	8 Hrs
Biomaterials in Medical Devices: Metals, polymers, ceramics, and composites as biomaterials, Selection criteria for biomaterials in medical devices, Biomaterials for cardiovascular applications, Biomaterials for orthopaedic applications, Biomaterials for tissue engineering and drug delivery.	
MODULE 3	8 Hrs
Artificial Organs - Design and Development: Introduction to artificial organs and their significance, Biomechanics and materials selection for artificial organs, Artificial organs for the cardiovascular system, Artificial organs for the respiratory system, Artificial organs for the renal system	
MODULE 4	8 Hrs
Biocompatibility and Safety Assessment: In vitro and in vivo biocompatibility testing of biomaterials, Toxicity and immunogenicity of biomaterials, Sterilization techniques and their impact on biomaterial properties, Failure analysis and post-implantation considerations, Risk assessment and safety regulations in the use of biomaterials and artificial organs.	
MODULE 5	8 Hrs
Advanced Topics in Biomaterials and Artificial Organs: Biomaterials for neural applications, Nano materials and their applications in biomedicine, Bioresorbable and smart biomaterials, Emerging trends in artificial organs, Case studies and research trends in biomaterials and artificial organs.	
TEXT BOOKS	
1. Biomaterials Science: An Introduction to Materials in Medicine by Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons	
2. Artificial Organs: Technology and Clinical Applications by Rolf Niedermayr, Rainer Kozlowski, Michael Niedermayr	
REFERENCE BOOKS	
1 Biomaterials: A Basic Introduction by Qizhi Chen.	
2 Biomaterials: Principles and Applications by Joon B. Park, R. S. Lakes.	
Online courses:	
1 "Introduction to Biomaterials" by Courserahttps://www.coursera.org/learn/biomaterials	
2 "Biomaterials for Artificial Organs" by edX Link: https://www.edx.org/course/biomaterials-for-artificial-organs	
3 "Biomaterials: Fundamentals and Applications" by NPTEL Link ttps://onlinecourses.nptel.ac.in/noc21_bt40/preview	
E-Books:	
1. "Biomaterials Science: An Introduction to Materials in Medicine" by Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons. Link: https://www.elsevier.com/books/biomaterials-science/ratner/978-0-12-816139-7	
2 "Artificial Organs: Technology and Clinical Applications" by Rolf Niedermayr, Rainer Kozlowski, Michael Niedermayr.	

	Hours

	https://ww.springer.com/gp/book/9783319045794
Choice of Module: Module 1 and Module 2	

Semester	**VIII**				
COURSE TITLE	**Brain Computer Interface**				
COURSE CODE	**22MD8PE4BC**	**Credits**	**3**	**L-T-P**	**2:1:0**
Total Hours of Pedagogy	**40**				
Pre-Requisites: Anatomy and Physiology of Brain. Knowledge of Biomedical signals and Transducers used for the biomedical signal acquisition.					

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

CO1	Apply the knowledge of mathematics science and engineering fundamentals to understand the Brain Organization, Anatomy, and Function.
CO2	Process and analyze the brain signals for artifact reduction.
CO3	Apply Machine Learning Techniques for the analysis of brain signals
CO4	Learn the principles of BCI System, applications and ethics.
CO5	Apply BCI Techniques using modern tools, present and submit the report.

CO-PO-PSO-Mapping:-

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3														3
CO2		3													3
CO3		3													3
CO4								3							3
CO5			3	3	3				2	2					3
Avg.	**3**	**3**	**3**	3	**3**			**3**	**2**	**2**					**3**

MODULE 1	8
Basic Neuroscience : Neurons ,Action Potentials or Spikes , Spike Generation ,Adapting the Connections. Brain Organization, Anatomy and Function . Recording and Stimulating the Brain ,Invasive Techniques ,Non-invasive Techniques Multielectrode Arrays, Signal Processing ,Spike Sorting.	
MODULE 2	8
Frequency Domain Analysis :Discrete Fourier Transform ,Fast Fourier Transform, Spectral Features ,Wavelet Analysis, Time Domain Analysis ,Hjorth Parameters , Fractal Dimension Bayesian Filtering ,Kalman Filtering , Particle Filtering ,Spatial Filtering , Bipolar, Laplacian, and Common Average Referencing. Artefact Reduction Techniques : Thresholding ,Band-Stop and Notch Filtering, Linear Modelling Principal Component Analysis ,Independent Component Analysis.	
MODULE 3	8
Machine Learning: Classification Techniques , Binary Classification ,Ensemble Classification Techniques ,Multi-Class Classification , Evaluation of Classification Performance ,Regression ,Linear Regression ,Neural Networks and Back propagation , Radial Basis Function (RBF) Networks ,Gaussian Processes	
MODULE 4	8
Building a BCI :Major Types of BCIs ,Brain Responses Useful for Building BCIs ,Imagined Motor and Cognitive Activity, Stimulus-Evoked Activity. Invasive BCIs: Two Major Paradigms in Invasive Brain-Computer Interfacing ,BCIs Based on Operant Conditioning ,BCIs for Prosthetic Arm and Hand Control ,BCIs for Lower-Limb Control ,BCIs for Cursor Control ,Cognitive BCIs ,Cognitive BCIs in Humans , Establishing New Connections between Brain Regions.	
MODULE 5	8
Applications and Ethics: Applications of BCIs ,Medical Applications ,Sensory Restoration , Rehabilitation ,Restoring Communication with Menus, Lie Detection and Applications in Law ,Monitoring Alertness ,Estimating Cognitive Load , Ethics of Brain-Computer Interfacing Medical Health, and Safety Issues :Balancing Risks versus Benefits , Informed Consent BCI Security and Privacy , Legal Issues Moral and Social Justice Issues.	
TEXT BOOKS	
1. Brain -Computer Interfacing: An Introduction by Rajesh P. N Rao University of Washington DATE PUBLISHED: September 2013:ISBN:	
2. Brain-Computer Interfaces : Foundations and methods Maureen Clerc, Laurent Bougrain, Fabien Lotte	
REFERENCE BOOKS	
1 Brain-Computer Interfaces 2: Technology and Applications, Volume 2 Maureen Clerc, Laurent Bougrain, Fabien Lotte John Wiley & Sons, 29-Aug-2016 - Computers Schalk, G., & Mellinger, J. (2010).	
2 A Practical Guide to Brain–Computer Interfacing with BCI2000: General-Purpose Software for Brain-Computer Interface Research, Data Acquisition, Stimulus Presentation, and Brain Monitoring. Springer Science & Business	

	Media.	
Online courses		
1.	https://sccn.ucsd.edu/wiki/Introduction_To_Modern_Brain-Computer_Interface_Design	
2.	https://www.udemy.com/course/brain-computer-interface/	
E-Books:		
1	Dornhege, G. (Ed.). (2007). Toward brain-computer interfacing. MIT press.	
2	"Brain-Computer Interfaces: Principles and Practice" ISBN-13: 978-0195388855	
Choice of Module: Module 2 and Module 5		

Semester	**VIII**				
COURSE TITLE	**Artificial Intelligence for Healthcare**				
COURSE CODE	**22MD8OE3AI**	**Credits**	**3**	**L-T-P**	**3-0-0**
Total Hours of Pedagogy	**40**				
Pre-Requisites: Any programming skills, logical reasoning					

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

CO1	Understand the concept of agents, environments, search strategies, reasoning, logic and probabilities.
CO2	Solve problems using uninformed and informed search strategies
CO3	Represent procedural and declarative knowledge by applying agent-based rules.
CO4	Provide logic-based analysis for question and answering techniques
CO5	Formulate probabilities for handling uncertain knowledge.

CO-PO-PSO-Mapping:-

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2		3											3		
CO3	3												3		
CO4		3													3
CO5				2											2

Avg.	**3**	**3**		**2**									**3**		2

	Hrs
MODULE 1	8
Introduction: Introduction and Fundamentals of AI, Foundations and History of AI Intelligent Agents: Agents and environment, Concept of Rationality, The nature of environment, The structure of agents. Problem-solving: Problem-solving agents, Example problems, Searching for Solutions. **Ai In Health Diagnostics: Opportunities And Issues For Clinical Practice**	
MODULE 2	8
Logical Agents: Knowledge–based agents, The Wumpus world, Logic, Propositional logic, Propositional theorem proving, Effective propositional model checking, Agents based on propositional logic. First Order Logic: Representation Revisited, Syntax and Semantics of First Order logic, Using First Order logic. Case study	
MODULE 3	8
Logical Agents: Knowledge–based agents, The Wumpus world, Logic, Propositional logic, Propositional theorem proving, Effective propositional model checking, Agents based on propositional logic. First Order Logic: Representation Revisited, Syntax and Semantics of First Order logic, Using First Order logic. Case study	
MODULE 4	8
Inference in First Order Logic : Propositional Versus First Order Inference, Unification, Forward Chaining, Backward Chaining, Resolution. Proliferation Of Devices And Apps For Data Collection And Analysis	
MODULE 5	8
Uncertain Knowledge and Reasoning: Quantifying Uncertainty: Acting under Uncertainty, Basic Probability Notation, Inference using Full Joint Distributions, Independence, Baye's Rule and its use. Wumpus World Revisited Probabilistic Reasoning: Representing Knowledge in an Uncertain Domain, Semantics of Bayesian Networks. Case studies : AI for diagnosis and prediction of diseases.	

TEXT BOOKS	
1	Artificial Intelligence Stuart J. Russell and Peter Norvig 3rd Pearson edition 2015
2	Artificial Intelligence Applications for Health Care by Mitul Kumar Ahirwal, Narendra D. Londhe, Anil Kumar Copyright 2022 CRC Press
REFERENCE BOOKS	
1	Artificial Intelligence Elaine Rich, Kevin Knight, Shivashankar B Nair Third Tata MCGraw Hill 2013.
2	Artificial Intelligence o- George F Luger Fifth Pearson Education 2009
Online courses	
1	https://www.edx.org/course/artificial-intelligence-uc-berkeleyx-cs188-1x
2	https://www.udacity.com/course/intro-to-artificial-intelligence--cs271
E-Books:	

1	http://www.e-booksdirectory.com/details.php?ebook=9845
2	http://www.e-booksdirectory.com/details.php?ebook=5643
Choice of Module: Module 3 and Module 5	

Semester	**VIII**				
COURSE TITLE	**FUNDAMENTALS OF ROBOTICS**				
COURSE CODE	**22MD8OE3FR**	**Credits**	**3**	**L-T-P**	**3:0:0**
Total Hours of Pedagogy	**40**				
Pre-Requisites: Digital circuits, Sensors and Actuators					

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

CO1	Apply the knowledge of process automation for the working of robot
CO2	Analyze the function of sensors and actuators in the robot
CO3	Develop a fuzzy logic to use a robot for a typical application
CO4	Engage students individually/ in a team to conduct a case study on robotics and document the same.

CO-PO-PSO-Mapping:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												2		
CO2		3											2		
CO3			3										2		
CO4			2		2				2	2			2		
Avg.	**3**	**3**	**3**		**3**				**2**	**2**			**2**		

UNIT 1	8
BASIC CONCEPTS: **Introduction, Classification of Robots, Robot Components, Degrees of freedom, Joints and** Coordinates, Reference frames, Programming modes, Robot Characteristics and Application. **Robot Kinematics:** Position analysis introduction, Robots as mechanisms, Matrix representation, Homogeneous transformation matrices, representation of transformations.	
UNIT 2	8
ACTUATORS: Introduction, Characteristics of Actuating systems, Hydraulic devices, Pneumatic devices, Electric motors, Microprocessor control of Electric motors, Magnetostrictive actuators, Shape-Memory type metals, Speed reduction.	

UNIT 3		8
SENSORS: Sensor characteristics, Position sensors, Velocity sensors, Acceleration sensors, Force and Pressure sensor, Torque sensors, Microswitches, Light and IR sensors, Touch and Tactile sensors, Proximity sensors, Range finders, Sniff sensors, vision systems, voice recognition devices, voice synthesizers.		
UNIT 4		8
VISION SYSTEMS: Image acquisition, Frequency vs. spatial domain, Frequency contents: Noise, edges, Convolution mask, Sampling and quantization, Image processing techniques, Noise reduction, Morphological operation, Object recognition, depth measurement, Real-Time Image processing.		
UNIT 5		8
Fuzzy Logic Control: Introduction, Fuzzy control, Crisp values vs. Fuzzy values, Fuzzy sets, Fuzzification, Inference rule base, Defuzzification, Simulation of Fuzzy logic controller, Applications of Fuzzy logic in Robotics.		
TEXT BOOKS		
1	Saeed B. Niku, "Introduction to Robotics", Prentice-Hall India	
2	Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., "Industrial Robotics", Mc Graw-Hill Singapore	
3	Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai	
REFERENCE BOOKS		
1	Deb. S.R.,"Robotics Technology and flexible Automation", John Wiley, USA	
2	Klafter R.D., Chimielewski T.A., Negin M., "Robotic Engineering – An integrated approach", Prentice Hall of India, New Delhi,	
3	Mc Kerrow P.J. "Introduction to Robotics", Addison Wesley, USA	
4	Issac Asimov "Robot", Ballantine Books, New York	
Online courses		
1	https://nptel.ac.in/courses/112105249	
2	https://nptel.ac.in/courses/107106090	
E-Books:		
1	http://www.robot.bmstu.ru/files/books/(Ebook%20-%20English)%20Mcgraw-Hil,%20Pic%20Robotics%20%20A%20Beginner'S%20Guide%20To%20Robotic.pdf	
2	https://doc.lagout.org/science/0_Computer%20Science/8_Electronics%20%26%20Robotics/Robotics%20and%20Automation%20Handbook.pdf	

Semester	**VIII**				
COURSE TITLE	**Nano electronics**				
COURSE CODE	**22MD8OE3NE**	**Credits**		**L-T-P**	**3:0:0**
Total Hours of Pedagogy	**40**				
Pre-Requisites: Engineering Physics, Engineering Chemistry, Analog electronics.					

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

CO1	Apply the fundamental principles of physics in nano electronics.
CO2	Analyze the properties and behavior of nanomaterials for a given application.
CO3	Analyze various nanofabrication techniques used in nano electronics.
CO4	Design and develop engineering solutions using nanoelectronics.
CO5	Evaluate the challenges and potential future advancements in the field of nano electronics. Document and present the same in a team.

CO-PO-PSO-Mapping:-

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2		3											3		
CO3		3											3		
CO4			3										3		
CO5				2					2	2			3		
Avg.	**3**	**3**	**3**	**2**					**2**	**2**			**3**		

	Hours
MODULE 1	8Hrs
Introduction to Nano Electronics: Overview of nano electronics, Definition, significance, and applications, Fundamentals of quantum mechanics and its relevance to nano electronics, Nanostructures and their properties: Quantum confinement, bandgap engineering, and size effects, Challenges and opportunities in nano electronics.	
MODULE 2	8Hrs
Introduction to nanomaterials: Nanowires, nanoparticles, and carbon-based	

materials, Properties and characterization of nanomaterials for electronic applications, Synthesis and fabrication techniques for nanomaterials, Hybrid nanomaterials and their applications in medical electronics.	
MODULE 3	8Hrs
Nanofabrication Techniques: Top-down and bottom-up approaches to nanofabrication, Electron beam lithography and nanoimprint lithography, Self-assembly and molecular self-assembly techniques, Nanomanipulation and nanolithography for device fabrication.	
MODULE 4	8Hrs
Nanoscale Electronic Devices: Nanotransistors: Carbon nanotube transistors, nanowire transistors, and graphene-based transistors, Nanosensors and biosensors for medical applications, Nanoelectromechanical systems (NEMS) and their applications, Nanophotonics and plasmonics in medical electronics	
MODULE 5	8Hrs
Applications of Nano Electronics in Medical Devices: Nanoelectronics in biomedical imaging and diagnostics, Nanobiosensors for monitoring and sensing biological signals, Nanoparticles for targeted drug delivery and therapeutics, Emerging trends and future prospects in nano electronics for medical applications	

TEXT BOOKS	
1	Nanoelectronics: Principles and Devices by Sergey Edward Lyshevski
2	Introduction to Nanoelectronics: Science, Nanotechnology, Engineering, and Applications by Vladimir V. Mitin, Viatcheslav A. Kochelap, Michael A. Stroscio.

REFERENCE BOOKS	
1	Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum Devices by Krzysztof Iniewski
2	Introduction to Nanotechnology by Charles P. Poole Jr., Frank J. Owens

Online courses:	
1	"Nanotechnology and Nanosensors" by edX Link: https://www.edx.org/course/nanotechnology-and-nanosensors
2	Nanotechnology: Fundamentals and Applications" by Coursera Link: https://www.coursera.org/learn/nanotechnology
3	Nanoelectronics: Devices and Materials" by NPTEL Link: https://onlinecourses.nptel.ac.in/noc21_ee81/preview

E-Books:	
1.	Nanoelectronics: Materials, Devices, Applications, 2 Volumes Robert Puers (Editor), Livio Baldi (Editor), Marcel Van de Voorde (Editor), Sebastiaan E. van Nooten (Editor), ISBN: 978-3-527-80073-5 April 2017
2.	Introduction to Nano: basics to nanoscience and nanotechnology by Amretashis Sengupta (Editor); Chandan Kumar Sarkar (Editor)
3.	Nanotechnology, the Brain, and the Future by Sean A. Hays (Editor);

	Jason Scott Robert (Editor); Clark A. Miller (Editor); Ira Bennett (Editor)	
Choice of Module- Module 1 and Module 2		

Semester	**VIII**		
Course Title	**MAJOR PROJECT**	**Course Code**	**22MD8PWMPJ**
Credits	**6**	**L-T-P**	**0-0-6**

Course Outcomes	
CO1	Ability to apply knowledge to identify, gather information and analyse to formulate the unmet need and problem definition for project through survey
CO2	Ability to use appropriate tool/tools to implement and demonstrate the project.
CO3	Ability to design and develop sustainable solution/system for the biomedical applications.
CO4	Ability to make effective presentation of the work abiding professional ethics as an individual and a team member.
CO5	Ability to develop systems with scope for enhancement and continue life-long learning.

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3		3									3	3	3
CO2			3		3								3	3	3
CO3			3			3	3						3	3	3
CO4								3	3	3	3				
CO5												3			
Avg.	**3**	**3**	**3**	**3**	**3**	3	3	3	**3**	**3**	3	3	**3**	3	3

Rubrics	Synopsis Assessment	CO	POs	Marks
S1	Potential of work (Innovative / societal / research / Core)	1	1,2,4	5
S2	Objectives, Methodology and proposed plan of action	5	12	2
S3	Has the problem been arrived with a systematic literature survey/field survey?	1	1,2,4	5

S4	Technical writing ability/Quality of synopsis report writing following standards set by university/college	4	8,9,10,11	5
S5	Presentation with time management	4	8,9,10,11	3
			Total	20

Rubrics	Mid assessment	CO	POs	Marks
M1	Partial Demonstration of the project	5	1,2,4	4
M2	Degree of completion - is the project in line with the objectives set during synopsis phase	3	12	16
M3	Any additional of the proposed work based on previous suggestion	2	1,2,4	6
M4	References and preparation of presentation	4	8,9,10,11	10
M5	Presentation and Viva	4	8,9,10,11	4
			Total	40

Rubrics	Final assessment	CO	POs	Marks
F1	Complete Demonstration of the project	4	1,2,4	20
F2	Is the project completed as proposed	3	12	4
F3	Any additional of the proposed work based on previous suggestion is implemented	5	1,2,4	4
F4	Report writing	4	8,9,10,11	8
F5	Presentation and Viva	4	8,9,10,11	4
			Total	40

Rules and Regulations for UG VIII Semester Major Project work

1. Students Batch should not exceed 3 per group.
2. Students should make a team and register the batch with the Project Coordinator.
3. Each faculty will Guide 2 Projects
4. Problem Statement must be from Healthcare Domain.
5. Project Coordinator along with the Head of the Department shall form a review committee for project work for Synopsis.
6. There shall be three reviews during the semester for evaluating the CIE.

Semester	VIII		
Course Title	**Seminar on Industry Internship**	**Course Code**	**22MD8SRIN3**
Credits	**2**	**L-T-P**	**0-0-2**

CO#	**Internship and Seminar Outcomes**
CO 1	Apply the Engineering knowledge to engage in internship in an engineering domain, and comprehend the professional norms of the organization
CO 2	Identify the key engineering, management, science, mathematics concepts, being transformed to a successful organization
CO 3	identify the community that benefit from the product
CO 4	Identify and comprehend the professional norms and the model for sustainable development of the organization
CO 5	Identify the skills/concepts from various disciplines, and able to perform as a member of the multidisciplinary team
CO6	prepare the report on internship, three minute of the work carried out in industry under internship program

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3			3									3	3	3
CO2					3										
CO3			3			3	3								
CO4								3	3	3	3				
CO5												3			
Avg.	**3**	**3**	**3**	**3**	**3**	3	3	3	**3**	**3**	3	3	**3**	3	3

Rules and Regulation for Internship Seminar

- Students should perform an internship for duration of 8 to 16 weeks.
- Internship to be performed in healthcare domain in Industries or Hospital.
- The internships can be taken up in an industry, a government organization, a research organization or an academic institution, either in the country or outside the country
- Internship completion certificate should be produced in the report.
- An internship report should be submitted for the CIE and SEE assessment as per the rubrics of internship seminar.

Semester	**VIII**		
Course Title	**MOOC- 2**	**Course Code**	**22MD8NCMOC**
Credits	**NC**	**L-T-P**	**0**

Guidelines for MOOC :

1. Students should take MOOC Course of their choice particularly for knowledge and skill enhancement.
2. Students need to submit the certificate to obtain Pass grade.