SENGUNTHAR ENGINEERING COLLEGE
(AUTONOMOUS)
(Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai)
Recognized Under Section 2(f) & 12(B) of the UGC Act, 1956
NAAC Accredited with 'A' Grade
TIRUCHENGODE - 637 205 NAMAKKAL (Dt) TAMILNADU

ESTD 2001

CURRICULUM & SYLLABI

B.E. MEDICAL ELECTRONICS

(CHOICE BASED CREDIT SYSTEM)

(For the Students Admitted in the Academic Year 2022-2023 onwards)

REGULATIONS – 2019

SENGUNTHAR
Shrine 2 Success

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Note: The regulations hereunder are subject to amendments as may be decided by the Academic Council of the Sengunthar Engineering College from time to time. Any or all such amendments will be effective from such date and to such batches of candidates (including those already undergoing the program) as may be decided by the Academic Council.

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SCHEME FOR CURRICULUM

B.E. –MDE

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CURRICULUM AND SYLLABI
FOR B.E. / B.Tech. DEGREE PROGRAMMES
(For the Students Admitted in the Academic Year 2022-2023 onwards)

B.E- MEDICAL ELECTRONICS

Program Outcomes (PO)

Engineering Graduates will be able to:

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

2. **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.

3. **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.

4. **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.

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

6. **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.

7. **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.

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

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

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10. **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.

11. **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.

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

Program Specific Outcome (PSOs)

- Ability to understand the fundamental concepts, analyze, design, develop, implement using mathematical foundations and domain knowledge for medical equipment design and providing solutions to Problems, Challenges in Healthcare Industry by applying the new ideas and innovations on par with international standards

- Ability to work and communicate effectively in a team environment and foster the professional skills towards industrial and societal needs.

- Ability to grasp the advancements in hardware / software tools and creating a career path to become an entrepreneur, lifelong learner with moral values and ethics.

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CURRICULUM AND SYLLABI

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B.E- MEDICAL ELECTRONICS - FIRST SEMESTER

Course Code	Name of the Subject	Category	Periods / Week				Credit	Maximum Marks		
			L	T	P	C		CIA	ESE	TOT
19HST101	Communicative Techno English - I	HS	3	0	0	3		40	60	100
19MAT101	Engineering Mathematics - I	BS	3	1	0	4		40	60	100
19CYE101	Engineering Chemistry	BS	3	0	2	4		50	50	100
19PHE101	Engineering Physics	BS	3	0	2	4		50	50	100
19GET101	Engineering Graphics	ES	3	0	0	3		40	60	100
19GEE101	Computer Fundamentals and Python Programming	ES	3	0	2	4		50	50	100
19EEC101	Life Skills for Engineers	EEC	0	0	2	0		100	-	100
19MDC101	Induction Program (2 Weeks)	MC	-	-	-	-		-	-	-
TOTAL CREDITS IN SEMESTER - I			22							

HS   :   Humanities and Social Sciences

BS   :   Basic Sciences

ES   :   Engineering Sciences

PC   :   Professional Core

PE   :   Professional Elective

OE   :   Open Elective

EEC :   Employability Enhancement Courses

MC   :   Mandatory Courses

L   :   Lecture

T   :   Tutorial

P   :   Practical

C   :   Credit Point

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ESE :   End Semester Examination

TOT :   Total

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B.E- MEDICAL ELECTRONICS - SECOND SEMESTER

Course Code	Name of the Subject	Category	Periods / Week				Credit	Maximum Marks		
			L	T	P	C		CIA	ESE	TOT
19HST201	Communicative Techno English - II	HS	3	0	0	3		40	60	100
19CYT201	Environmental Science and Engineering	BS	3	0	0	3		40	60	100
19MAT201	Engineering Mathematics - II	BS	3	1	0	4		40	60	100
19MDT201	Medical Physics	PC	3	0	0	3		40	60	100
19GEE201	Basics of Electrical Machines	ES	3	0	2	4		50	50	100
19MDE201	Electronic Devices & Circuits	PC	3	0	2	4		50	50	100
19EEC203	Technical Skill (Hands on training in Electrical & Electronics)	EEC	0	0	2	0		100	-	100
19MDC201	NSS / YRC / RRC	MC	-	-	-	-		100	-	100
TOTAL CREDITS IN SEMESTER - II						21				

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BS : Basic Sciences

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B.E- MEDICAL ELECTRONICS -THIRD SEMESTER

Course Code	Name of the Subject	Category	Periods / Week				Credit	Maximum Marks		
			L	T	P	C		CIA	ESE	TOT
19MAT301	Transforms and Partial Differential Equations	BS	3	1	0	4		40	60	100
19MDT301	Anatomy and Human Physiology	PC	3	1	0	4		40	60	100
19EET304	Circuit Theory	PC	3	1	0	4		40	60	100
19ECE301	Digital Electronics	PC	3	0	2	4		50	50	100
19MDE301	Biosciences & Bio Analyzers	PC	3	0	2	4		50	50	100
19CSE303	Data Structures using C	ES	3	0	2	4		50	50	100
19EEC301	Communication Skills	EEC	0	0	2	0		100	-	100
19MDC301	Leadership Enhancement Programme	MC	1	0	0	0		100	-	100
TOTAL CREDITS IN SEMESTER - III			24							

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B.E- MEDICAL ELECTRONICS - FOURTH SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19MDT401	Human Assist Devices	PC	3	0	0	3	40	60	100
19MDT402	Control Systems for Medical Engineers	PC	3	1	0	4	40	60	100
19MDT403	Biosensors and Measurements	PC	3	0	0	3	40	60	100
19ECT301	Signals and Systems	PC	3	1	0	4	40	60	100
19MDE401	Medical Instrumentation	PC	3	0	2	4	50	50	100
19ECE402	Linear Integrated Circuits	PC	3	0	2	4	50	50	100
19EEC401	Entrepreneurship Development Activity	EEC	0	0	2	0	100	-	100
19MDC401	Value Added Course - I	MC	-	-	-	-	100	-	100
TOTAL CREDITS IN SEMESTER - IV			22						

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PE   :   Professional Elective

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B.E- MEDICAL ELECTRONICS - FIFTH SEMESTER

Course Code	Name of the Subject	Category	Periods / Week				Credit	Maximum Marks		
			L	T	P	C		CIA	ESE	TOT
19MDT501	Diagnostic and Therapeutic Equipments	PC	3	0	0	3		40	60	100
19MDT502	Bio Materials and Artificial Organs	PC	3	0	0	3		40	60	100
19ECE502	Digital Signal Processing	PC	3	0	2	4		50	50	100
19ECE503	Microprocessors and Microcontrollers	PC	3	0	2	4		50	50	100
	Professional Elective - I	PE	3	0	0	3		40	60	100
	Open Elective – I	OE	3	0	0	3		40	60	100
19EEC501	Quantitative Aptitude Learning	EEC	0	2	0	0		100	-	100
19MDC501	Value Added Course – II	MC	-	-	-	-		100	-	100
TOTAL CREDITS IN SEMESTER - V			20							

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PC   :   Professional Core

PE   :   Professional Elective

OE   :   Open Elective

EEC :   Employability Enhancement Courses

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B.E- MEDICAL ELECTRONICS - SIXTH SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19MDT601	Biostatistics and Research Methodology	PC	3	1	0	4	40	60	100
19MDT602	Radiological Equipments	PC	3	0	0	3	40	60	100
19MDT603	Electrical Safety and Quality Assurance in Hospital	PC	3	0	0	3	40	60	100
19MDE601	Digital Image Processing for Medical Engineers	PC	3	0	2	4	50	50	100
19ECE702	Embedded Systems	PC	3	0	2	4	50	50	100
	Professional Elective - II	PE	3	0	0	3	40	60	100
19MDJ601	Mini Project	EEC	0	0	2	1	40	60	100
19MDC601	Constitution of India	MC	3	0	0	0	100	-	100
TOTAL CREDITS IN SEMESTER - VI			22						

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B.E- MEDICAL ELECTRONICS - SEVENTH SEMESTER

Course Code	Name of the Subject	Category	Periods / Week				Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19MDT701	Hospital Administration and Waste Management	PC	3	0	0	3	40	60	100
19MDE701	Medical Electronic Devices and Design	PC	3	0	2	4	50	50	100
	Professional Elective - III	PE	3	0	0	3	40	60	100
	Open Elective - II	OE	3	0	0	3	40	60	100
19MDJ701	Hospital/Industry Training	EEC	0	0	2	2	40	60	100
TOTAL CREDITS IN SEMESTER - VII			15						

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BS : Basic Sciences

ES : Engineering Sciences

PC : Professional Core

PE : Professional Elective

OE : Open Elective

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B.E- MEDICAL ELECTRONICS - EIGHTH SEMESTER

Course Code	Name of the Subject	Category	L	T	P	C	CIA	ESE	TOT
			Periods / Week			Credit	Maximum Marks		
	Professional Elective - IV	PE	3	0	0	3	40	60	100
	Professional Elective - V	PE	3	0	0	3	40	60	100
19MDJ801	Project Work	EEC	0	0	20	12	40	60	100
TOTAL CREDITS IN SEMESTER - VIII			18						

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LIST OF PROFESSIONAL CORE (PC) COURSES

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19MDE201	Electronic Devices & Circuits	PC	3	0	2	4	50	50	100
19MDT201	Medical Physics	PC	3	0	0	3	40	60	100
19MDT301	Anatomy and Human Physiology	PC	3	1	0	4	40	60	100
19ECE301	Digital Electronics	PC	3	0	2	4	40	60	100
19MDE301	Biosciences & Bio Analyzers	PC	3	0	2	4	50	50	100
19EET304	Circuit Theory	PC	3	1	0	4	40	60	100
19MDT401	Human Assist Devices	PC	3	0	0	3	40	60	100
19MDT402	Control Systems for Medical Engineers	PC	3	1	0	4	40	60	100
19MDE401	Medical Instrumentation	PC	3	0	2	4	50	50	100
19ECT301	Signals and Systems	PC	3	1	0	4	40	60	100
19MDT403	Biosensors and Measurements	PC	3	0	0	3	40	60	100
19ECE402	Linear Integrated Circuits	PC	3	0	2	4	50	50	100
19MDT501	Diagnostic and Therapeutic Equipments	PC	3	0	0	3	40	60	100
19MDT502	Bio Materials and Artificial Organs	PC	3	0	0	3	40	60	100
19ECE502	Digital Signal Processing	PC	3	0	2	4	50	50	100
19ECE503	Microprocessor and Microcontroller	PC	3	0	2	4	50	50	100
19MDT601	Biostatistics and Research Methodology	PC	3	1	0	4	40	60	100
19MDT602	Radiological Equipments	PC	3	0	0	3	40	60	100
19ECE702	Embedded Systems	PC	3	0	2	4	50	50	100
19MDE601	Digital Image Processing for Medical Engineers	PC	3	0	2	4	50	50	100
19MDT603	Electrical Safety and Quality Assurance in Hospital	PC	3	0	0	3	40	60	100

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19MDT701	Hospital Administration and Waste Management	PC	3	0	0	3	40	60	100
19MDE701	Medical Electronic Devices and Design	PC	3	0	2	4	50	50	100

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LIST OF PROFESSIONAL ELECTIVE (PE) COURSES

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
PROFESSIONAL ELECTIVE - I									
19MDPX01	Bio MEMS	PE	3	0	0	3	40	60	100
19MDPX02	Intellectual Property Rights	PE	3	0	0	3	40	60	100
19MDPX03	Nano Technology and Applications	PE	3	0	0	3	40	60	100
19MDPX04	Computers in Medicine	PE	3	0	0	3	40	60	100
19MDPX05	Introduction to Bio Energy and Bio Fuels	PE	3	0	0	3	40	60	100
Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
PROFESSIONAL ELECTIVE - II									
19MDPX06	Medical Ethics & Standards	PE	3	0	0	3	40	60	100
19MDPX07	Neural Networks and its Applications	PE	3	0	0	3	40	60	100
19MDPX08	Body Area Networks	PE	3	0	0	3	40	60	100
19MDPX09	Medical Expert Systems	PE	3	0	0	3	40	60	100
19MDPX10	IoT in Healthcare	PE	3	0	0	3	40	60	100

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Course Code	Name of the Subject	Category	Periods / Week				Credit	Maximum Marks		
			L	T	P	C		CIA	ESE	TOT
PROFESSIONAL ELECTIVE – III										
19MDPX11	Rehabilitation Engineering	PE	3	0	0	3		40	60	100
19MDPX12	Virtual Reality in Medicine	PE	3	0	0	3		40	60	100
19MDPX13	Advanced Medical Image Analysis	PE	3	0	0	3		40	60	100
19MDPX14	Computational Neuroscience	PE	3	0	0	3		40	60	100
19MDPX15	Cardiovascular Engineering	PE	3	0	0	3		40	60	100
PROFESSIONAL ELECTIVE – IV										

Course Code	Name of the Subject	Category	Periods / Week				Credit	Maximum Marks		
			L	T	P	C		CIA	ESE	TOT
19MDPX16	Clinical Trials	PE	3	0	0	3		40	60	100
19MDPX17	Telehealth Technology	PE	3	0	0	3		40	60	100
19MDPX18	Pattern Recognition and Artificial Intelligence	PE	3	0	0	3		40	60	100
19MDPX19	Brain Computer Interface and its Applications	PE	3	0	0	3		40	60	100
19MDPX20	Biometric Systems	PE	3	0	0	3		40	60	100

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Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
PROFESSIONAL ELECTIVE – V									
19MDPX21	Physiological Modeling	PE	3	0	0	3	40	60	100
19MDPX22	Biomechanics	PE	3	0	0	3	40	60	100
19MDPX23	Introduction to Cell Biology	PE	3	0	0	3	40	60	100
19MDPX24	Wearable Technology	PE	3	0	0	3	40	60	100
19MDPX25	Computer Vision	PE	3	0	0	3	40	60	100

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B.E. - MDE: LIST OF OPEN ELECTIVE COURSES FOR OTHER BRANCHES

Course Code	Name of the Subject	Category	L	T	P	C	CIA	ESE	TOT
			Periods / Week			**Credit**	**Maximum Marks**		
OPEN ELECTIVE - I									
19MDOX01	Hospital Management	OE	3	0	0	3	40	60	100
19MDOX02	Principles of Radio Diagnosis and Radio Therapy	OE	3	0	0	3	40	60	100
19MDOX03	Medical Robotics	OE	3	0	0	3	40	60	100
19MDOX04	Hospital Construction planning and Organization Behavior	OE	3	0	0	3	40	60	100
19MDOX05	IoT in Healthcare	OE	3	0	0	3	40	60	100
OPEN ELECTIVE - II									
Course Code	Name of the Subject	Category	L	T	P	C	CIA	ESE	TOT
			Periods / Week			**Credit**	**Maximum Marks**		
19MDOX06	Medical Informatics	OE	3	0	0	3	40	60	100
19MDOX07	Biomedical Instrumentation	OE	3	0	0	3	40	60	100
19MDOX08	Hospital Waste Management	OE	3	0	0	3	40	60	100
19MDOX09	Medical Equipment Design	OE	3	0	0	3	40	60	100
19MDOX10	Medical Imaging Techniques	OE	3	0	0	3	40	60	100

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CURRICULUM AND SYLLABI FOR NCC AIRFORCE

(For the NCC Cadets of B.E. Degree Programmes)

LIST OF GENERAL ELECTIVE (GE) COURSES

Course Code	Name of the Subject	Category	Hours / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19NCCL01	NCC AIRFORCE LEVEL-1	GE	2	0	2	3	40	60	100
19NCCL02	NCC AIRFORCE LEVEL - 2	GE	2	0	2	3	40	60	100
TOTAL CREDITS					6				

SCHEME FOR SYLLABI

B.E. –MDE

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SEMESTER I

19HST101	COMMUNICATIVE TECHNO ENGLISH – I	L T P C
	(Common to all departments)	3 0 0 3

OBJECTIVES

To enable students to:

- Understand the basics of the English Language in a graded manner.
- Enrich vocabulary for the development of all the four language skills (LSRW).
- Develop speaking skills through self introduction and delivering speeches.
- Write e-mails, informal letters.
- Improve writing skills to express thoughts freely.

UNIT I: VOCABULARY   8

Synonyms and Antonyms - Single Word Substitutes - Use of Abbreviations and Acronyms- Homonyms and Homophones- Business Vocabulary - Commonly Confused Words- Collocation - British and American Vocabulary- Word formation. Activity: Grammar worksheets on the given topics.

UNIT II: GRAMMAR   10

Parts of speech - Comparative Adjectives - Numerical Adjectives - Be, Have and Do verbs- modal verbs-Types of Questions - Tenses - Impersonal Passive Voice - Direct and Indirect Speech- Gerunds and Infinitives - Same Word Used as Different Parts of Speech.

Activity: Grammar worksheets on the given topics.

UNIT III: INFORMAL WRITING   9

Letter Writing - Informal Letters - e-mail Writing - Informal Dialogues - Essay Writing- InformalEssays- Movie Reviews -Writing Instructions.

Activity: Giving topic and ask the students to write informal letters, e-mail.

UNIT IV: LANGUAGE ENHANCEMENT THROUGH SPEAKING   9

Self Introduction - (exchanging personal information) personal information, hobbies, strengths and weaknesses, likes and dislikes, special features of home town. Narrating Personal Experiences and Incidents- Two minute talk- Debate discussion.

Activity: Ask the students to speak about the above given topics.

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UNIT V: READING SKILLS   **9**

Reading Comprehension - reading techniques, pre-reading, post-reading, comprehension questions (multiple choice questions or short questions) - Short comprehension passages,

Practice skimming-scanning and predicting - Reading the passage and taking (Note making) Notes- Scan and understand main contents of the passage.

Activity: Giving topic and ask the students to find out answers for given passage**.**

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Learn to acquire usage of English.
- Use a wide range of vocabulary in oral and written communication.
- Give short informal presentations and participate in classroom discussions.
- Write informal letters and other communications.
- Frame grammatically correct sentences.

TEXT BOOKS

1. Board of Editors. Using English A Course book for Under graduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2015.
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES

1. Department of English, Anna University, "Mindscapes: English for Technologists and Engineers", 1st Edition, Orient Black Swan, Chennai. 2012.
2. Title: Developing Communication Skills. Publisher: MacMillan. Author: Krishna Mohan,Meera Banerji. Edition: Paperback 20

E-RESOURCES

1. https://nptel.ac.in/courses/109/106/109106094/ - (Introduction to Vocabulary)
2. https://nptel.ac.in/courses/109/106/109106129/ - (Reading Comprehension)

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19MAT101   **ENGINEERING MATHEMATICS - I**   **L T P C**
                                    (Common to all departments)   **3 1 0 4**

OBJECTIVES

To enable students to:

- Develop the use of matrix algebra techniques that are needed by engineers for practical applications.
- Familiarize the students with differential calculus.
- Describe the student with functions of several variables.
- Explore the students understand various techniques of integration.
- Acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

UNIT I: MATRICES   9+3

Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigen values and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II: DIFFERENTIAL CALCULUS   9+3

Representation of function – Limit of a function – Continuity – Derivatives – Differentiation rule – Maximum and Minimum values – Absolute Maximum and Minimum – Local Maximum and Minimum.

UNIT III: FUNCTIONS OF SEVERAL VARIABLES   9+3

Partial differentiation -Homogeneous functions and Euler's theorem - Total derivative - Jacobians -Taylor's series for functions of two variables - Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT IV: INTEGRAL CALCULUS   9+3

Definite and Indefinite integral – Substitution rule – Integration by parts - Trigonometric substitutions – Integration of rational function by partial fraction – Improper integrals – Bernoulli's formula.

UNIT V: MULTIPLE INTEGRALS   9+3

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

TOTAL: 45+15=60 PERIODS

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OUTCOMES

Upon completion of the course, the students will be able to:

- Classify the matrix algebra methods for solving practical problems.
- Discover differential calculus tools in solving various application problems.
- Develop differential calculus ideas on several variable functions.
- Compare different methods of integration in solving practical problems.
- Apply multiple integral ideas in solving areas, volumes and other practical problems.

TEXT BOOKS

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.

2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015.

REFERENCES

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.

2. Jain R.K. and Iyengar S.R.K., — Advanced Engineering Mathematics, Narosa Publications, New Delhi, 3rd Edition, 2007.

E-RESOURCES

1. https://nptel.ac.in/courses/111/105/111105121/ - (Rolle`s Theorem)
2. https://nptel.ac.in/courses/111/105/111105035/ - (Linear Algebra)

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19CYE101　　　　　**ENGINEERING CHEMISTRY**　　　　　**L T P C**
　　　　　　　　　　(Lab Embedded Theory Course)　　　　　　**3 0 2 4**
　　　　　　　　　　(Common to all departments)

OBJECTIVES

To enable students to:

- Classify the impurities of water and know the treatment and the conditioning methods for domestic and industrial uses.
- Outline about fundamentals, properties and moulding process of polymers.
- Discuss the types of corrosion and control measures and working of batteries.
- Explain about the phase rule and its applications to engineering field and also gain knowledge about the properties of alloys.
- Summarize the basics of Nanochemistry, synthesis, properties and applications of Nano materials.
- Acquire practical skills in the determination of water quality parameters, molecular weight of polymer, rate corrosion through volumetric and instrumental analysis.

UNIT I:　WATER TECHNOLOGY　　　　　　　　　　　　　　　　　　**9**

Introduction - Characteristics - hardness - estimation of hardness by EDTA method - alkalinity and its estimation - Boiler feed water - requirements - Boilers troubles (Scale and Sludge) - Internal conditioning (colloidal - phosphate - calgon and carbonate conditioning methods) - External conditioning - zeolite process, demineralization process - Desalination of brackish water by reverse osmosis - Municipality water treatment - Break point chlorination.

UNIT II:　POLYMER CHEMISTRY　　　　　　　　　　　　　　　　　　**9**

Introduction - Classification of polymers - Natural and synthetic; Thermoplastic and Thermosetting. Functionality - Degree of polymerization. Types of polymerization: Addition condensation and copolymerization, Properties of polymers: Tg, Tacticity, Molecular weight - weight average, number average and polydispersity index. Preparation, properties and uses of PVC, Nylon 6,6, Polyethylene - Rubbers - types - vulcanization of rubber - Plastics - Moulding constituents of plastics - Moulding of plastics - compression, injection and blow moulding-Biodegradable polymers-Conducting polymers.

UNIT III:　CORROSION AND BATTERY TECHNOLOGY　　　　　　　　　**9**

Corrosion - Types - Chemical Corrosion - Electrochemical Corrosion (galvanic and differential aeration) - Factors influencing corrosion - Material selection and design aspects - control

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methods of corrosion - Sacrificial anodic and impressed current cathodic protection -Protective coatings - paints - constituents and their functions - electroplating of Copper - electroless plating of Nickel. Batteries: Definition, Types - example, Lead acid battery, Lithiumion battery - H_2 - O_2 fuel cell- solar cell.

UNIT IV: PHASE RULE AND ALLOYS   9

Phase rule - explanation of terms involved - one component system - water system - condensed phase rule - construction of phase diagram by thermal analysis - simple eutectic systems (lead - silver system only).Alloys: Introduction- definition- properties of alloys- significance of alloying, functions and effect of alloying elements - ferrous alloys - nichrome and stainless steel - heat treatment of steel, non-ferrous alloys - brass and bronze.

UNIT V: CHEMISTRY OF NANO MATERIALS   9

Nano chemistry -   Basics (Surface area to volume ratio - Quantum confinement   -   (0D, 1D, 2D &3D) - Distinction between Molecules, Nanoparticles and Bulk Materials - Characterisation of nano materials using XRD and SEM. Synthesis of nano materials: Top down approach - Ball milling - Bottom up approach - Sol-gel method, Chemical vapour deposition - Properties of nanomaterials and Applications of Nanomaterials (Nano products of today).

LIST OF EXPERIMENTS
(Any Eight Experiments to be conducted)

1. Determination of total, temporary & permanent hardness of water by EDTA method.
2. Determination of alkalinity in water sample.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by Argentometric method.
5. Determination of strength of given hydrochloric acid using pH meter.
6. Estimation of sodium and potassium present in water using flame photometer.
7. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
8. Conductometric titration of strong acid vs strong base.
9. Corrosion experiment-weight loss method.
10. Estimation of copper content in the brass by Iodometry.
11. Determination of pH of soil.

TOTAL: 45+15=60 PERIODS

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OUTCOMES

Upon completion of the course, the students will be able to:

- Identify the method of removal of impurities from water for domestic and industrial purpose.

- Identify the different types of polymers, polymerisation processes and some special properties and applications of polymers.

- Analyze the causes of corrosion and discuss the control measures and discuss the functions of batteries.

- Apply of phase rule to alloy making for various engineering applications.

- Discuss the fundamentals of the nano materials and nano products of today.

- Outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

TEXT BOOKS

1. Jain P.C and Monika Jain, "Engineering Chemistry", Dhanpet Rai Publishing Company(P) Ltd.,New Delhi, 2013.

2. Viswanathan B, "Nanomaterials" Alpha Science International Ltd, 2009.

REFERENCES

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand &Company LTD, New Delhi, 2015.

2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd,New Delhi, 2012.

E-RESOURCES

1. https://nptel.ac.in/downloads/122101001/ - (Corrosion)
2. https://nptel.ac.in/courses/122/101/122101001/ - (Atomic Structure)

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19PHE101 **ENGINEERING PHYSICS** L T P C
(Lab Embedded Theory Course) 3 0 2 4
(Common to all departments)

OBJECTIVES

The main objective of this course is to:

- Recognize the structure of crystalline materials using crystallographic knowledge.
- Apply the knowledge of material's elasticity, stress, strain for industrial applications.
- Generalize the fundamentals of lasers and optical fibres, as well as their applications.
- Investigate the complex physical phenomenon using the fundamental principles of quantum mechanics and Schrödinger's wave equation.
- Design the structures with acoustics, ultrasonic production for structural applications.
- Judge the Engineering Physics that can be applied to optics, thermal physics, matter characteristics and to determine fluid properties.

THEORY PART:

UNIT I: STRUCTURE OF SOLIDS 9

Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d -Spacing in Cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Crystal Growth Techniques –Solution, melt (Bridgman and Czochralski) and Vapour growth techniques(qualitative).

UNIT II: ELASTICITY 9

Elasticity – Stress-Strain diagram and its uses - Factors affecting elastic modulus and tensile strength – Torsional stress and deformations – Twisting couple - Torsion pendulum: theory and experiment - Bending of beams :Bending moment – Cantilever: Theory and Experiment – Uniform and Non-uniform bending: Theory and experiment - I- Shaped girders.

UNIT III: PHOTONICS 9

Introduction to interaction of radiation with matter- Spontaneous and Stimulated emission- Population Inversion - Derivation of Einstein's A and B coefficients – Principle and working of Laser - Nd:YAG laser - Direct bandgap and indirect band gap semiconductors - Semiconductor diode Laser- Principle and propagation light in optical fibres- Derivation of Numerical aperture and Acceptance angle - Fibre optic communication system.

UNIT IV: QUANTUM PHYSICS 9

Black body radiation – Planck's theory (derivation) – Compton Effect: theory and experimental verification – Wave particle duality – Electron diffraction – Concept of wave function and its

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Physical significance – Schrödinger's wave equation: Time independent and time dependent equations – Particle in a one-dimensional rigid box- Quantum Tunnelling –Tunnelling Electron Microscope.

UNIT V: ACOUSTICS AND ULTRASONICS   9

Classification of sound- decibel- Weber–Fechner law – Sabine's formula - Derivation using growth and decay method – Absorption Coefficient and its determination – Factors affecting acoustics of buildings and their remedies Introduction- Classification of Sound waves - Production of Ultrasonic's by magnetostriction and piezoelectric methods - Acoustic grating – Cavitations - Applications of Ultrasonic's

LABORATORY PART
LIST OF EXPERIMENTS

(Eight experiments are to be conducted in Lab and two experiments are to be conducted virtually)

1. Laser: Determination of wavelength of laser and particle Size.
2. Fibre Optics: Determination of Numerical Aperture and Acceptance angle.
3. Determination of wavelength of mercury spectrum- Spectrometer.
4. Determination of Young's modulus – Non- Uniform bending.
5. Determination of Young's modulus - Uniform bending.
6. Torsional Pendulum: Determination of moment of inertia and rigidity modulus.
7. Determination of velocity of ultrasonic in liquid.
8. Determination of Viscosity of a liquid –Poiseulle's Method
9. Photoelectric Effect.**(Virtual)**
10. Determination of band gap of semiconductor.**(Virtual)**

TOTAL: 45 + 15= 60 PERIODS

OUTCOMES

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

*   Familiarize the structure of crystalline solids by applying knowledge of crystallography.
*   Analyze theories of failure and yield criteria as an elements of properties of matter.
*   Learn the basics of lasers and optical fibers and their use in some applications
*   Apply the basic principles of quantum mechanics and Schrödinger's wave equation to study the complex physical phenomenon
*   Comprise the fundamentals of Acoustics, production and applications of ultrasonic's.
*   Compose principles of elasticity, optics and acoustic properties in engineering applications through experiments.

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TEXT BOOKS

1. Avadhanulu M.N & Kshirsagar P.G "Text Book of Engineering Physics". S.Chand, 2006

2. P.Mani, "Engineering Physics Practicals", Dhanam Publications, 2019

REFERENCES

1. Raghavan V, Materials Science and Engineering: A First Course, PHI Publications, 2015

2. Rajendran V."Engineering Physics". Tata McGraw Hill Publications, 2012

E-RESOURCES

1. https://www.classcentral.com/course/youtube-basic-courses-engineering-physics

2. https://www.courses.com/physics

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19GET101	ENGINEERING GRAPHICS	L T P C
	(Common to all departments)	3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Understand the principles in graphic skill to communicate the concepts, ideas and design of engineering components.
- Learn projections of points, lines, planes viewed in different positions.
- Learn the projection of solids viewed in different positions.
- Gain the knowledge about the section of solids and development of surfaces of the given solids.
- Expose the international standards of technical drawing.

UNIT I: GENERAL PRINCIPLES OF ORTHOGRAPHIC PROJECTION   9
Graphics significance in engineering applications - study of drafting instruments - BIS conventions and specifications - Size, layout and folding of drawing sheets - principle of Letter writing and dimensioning. Projections of points, lines and planes. Principles of orthographic projection - First angle projection only - Layout of views - Projection of points located in all quadrant - Projection of polygonal surface and circular lamina inclined to both reference planes.

UNIT II: PROJECTION OF SOLIDS   9
Projections of solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.

UNIT III: SECTION OF SIMPLE SOLIDS   9
Section of solids - prisms, pyramids, cylinder and cone. Obtaining sectional views and true shape when the axis of the solid is vertical and cutting plane inclined to one reference plane.

UNIT IV: DEVELOPMENT OF SURFACES   9
Development of lateral surfaces of simple and truncated solids - prisms, pyramids, cylinders and cones with cutout, perpendicular and inclined to the horizontal axis.

UNIT V: ISOMETRIC AND PERSPECTIVE PROJECTIONS   9
Principles of isometric projection - isometric scale - isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones. Conversion of isometric projection into orthographic projection. Perspective projection of prisms, pyramids and cylinders by visual ray method.

TOTAL: 45 PERIODS

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OUTCOMES

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

- Construct multiple views of engineering components.
- Prepare the pictorial drawings as per the standards.
- Develop the projection of solids.
- Draw the section of solids drawings and development of surfaces of given objects.
- Apply free hand sketching and concept of isometric in engineering practice.

TEXT BOOKS

1. Venugopal K. and Prabhu Raja V., - "Engineering Graphics", 15th Edition, New Age International (P) Limited, New Delhi, 2018.
2. Natarajan K.V., "Engineering Graphics", 32nd Edition, Dhanalakshmi Publishers, Chennai,2019.

REFERENCES

1. K.R. Gopalakrishna, "Engineering Drawing Volume 1 & 2", 55th Edition Subhas Publications, Bangalore, 2017.
2. T.Jeyapoovan., "Engineering Graphics using Auto CAD" third edition vikas publishing house Pvt Ltd, New Delhi, 2017.

E - RESOURCES

1. https://nptel.ac.in/courses/112/103/112103019/ - (Geometric Constructions)
2. https://nptel.ac.in/courses/105/104/105104148/ - (Projections)

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19GEE101   COMPUTER FUNDAMENTALS AND PYTHON PROGRAMMING   L T P C
(Lab Embedded Theory Course)   **3 0 2 4**
(Common to all departments)

OBJECTIVES

The course objectives are to:

- Enable the student to learn the major components of a computer system and software.
- Know the basics of algorithmic problem solving and fundamentals of python programming.
- Develop simple python programs.
- Define controls and functions in python.
- Use python data structures - lists, tuples and dictionaries.

UNIT I: INTRODUCTION   9

Introduction, Characteristics of Computers, Generation and Classifications of Computers, Basic Computer Organization, Computer Software, Types of Software, Software Development Steps, Internet, Getting connected to Internet Applications.

UNIT II: PROBLEM SOLVING AND PYTHON FUNDAMENTALS   9

Algorithms, building blocks of algorithms (instructions/statements, state, control f low, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Introduction to Python: Basics of Python and history of Python - Unique features of Python, interpreter and interactive mode - values and types: int, float, boolean, string, and list; variables.

UNIT III: EXPRESSIONS AND STATEMENTS   9

Expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT IV: CONTROL FLOW AND FUNCTIONS   9

Conditionals: Boolean values and operators, conditional (if), alternative (if -else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions, Strings, Lists as arrays. Illustrative programs: square root, gcd, Tower of Hanoi, exponentiation, sum an array of numbers, linear search, binary search.

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UNIT V: LISTS, TUPLES AND DICTIONARIES   9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension.

LIST OF EXPERIMENTS

1. Document Creation, Table Creation and Flow chart.
2. Spread sheet- Chart, Formula, Sorting.
3. Compute the GCD of two numbers.
4. Find the square root of a number (Newton's method).
5. Exponentiation (power of a number).
6. Find the maximum of a list of numbers
7. Linear search and Binary search.
8. First n prime numbers.
9. Multiplication of two matrices.
10. Simulate elliptical orbits in Pygame.

TOTAL: 45+15=60 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

* Know the Computer basics, Components and Software's
* Develop algorithmic solutions to simple computational problems and Read, write, execute by hand simple Python programs.
* Structure simple Python programs for solving problems.
* Decompose a Python program into functions.
* Represent compound data using Python lists, tuples, and dictionaries.

TEXT BOOKS

1. Ashok.N.Kamthane," Computer Programming", Pearson Education (India),(2015).
2. Allen B. Downey, ''Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python3, Shroff /O'Reilly Publishers,2016 http://green tea press.com/wp/think- python/).

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REFERENCES

1. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python '' - Revised and updated for Python 3.2, Network Theory Ltd., 2011.

2. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.

E-RESOURCES

1. https://nptel.ac.in/courses/106/106/106106145/ - (Introduction to Algorithms)

2. https://nptel.ac.in/courses/106/106/106106182/ - (Joy of Computing)

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19EEC101	LIFE SKILLS FOR ENGINEERS	L T P C
	(Employability Enhancement Course)	0 0 2 0
	(Common to all departments)	

OBJECTIVES

To enable students to:

- Develop communication competence for engineers and enable them to convey thoughts and ideas with clarity and focus.
- Inculcate critical thinking process on problem solving.
- Have an overview on career skills required in their profession.
- Learn professional Ethics and Moral values
- Lead a team with more responsibilities to be succeeded in their Endeavour.

UNIT I: COMMUNICATION SKILL   **6**

Introduction to Communication, The Process of Communication, Barriers to Communication, Listening Skills, Non-verbal Communication and Body Language, Interview Skills, Group Discussion, Presentation Skills, Technology-based Communication- Technical Presentation

UNIT II: CRITICAL THINKING & PROBLEM SOLVING   **6**

Creativity, Lateral thinking, Critical thinking, Multiple Intelligence, Problem Solving, Mind Mapping & Analytical Thinking.

UNIT III: CAREER SKILLS   **6**

Introduction to Employability and Career Skills - developing a long-term career plan - making career changes -Time Management - General awareness of Current Affairs - Stress management - Team work - Career planning.

UNIT IV: ETHICS MORAL & PROFESSIONAL VALUES   **6**

Human Values, Civic Rights, Engineering Ethics, Engineering as Social Experimentation, Environmental Ethics, Global Issues.

UNIT V: LEADERSHIP SKILLS AND UNIVERSAL HUMAN VALUES   **6**

Leadership, Levels of Leadership, Making of a leader, Types of leadership, Universal Human Values: Non-Violence - Righteousness - Peace - Service – Renunciation.

TOTAL: 30 PERIODS

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OUTCOMES

Upon completion of the course, the students will be able to:

- Communicate effectively and make effective presentations.
- Think critically on a particular problem solving.
- Explore the career skills with stress management.
- Implement the professional Values and ethics.
- Lead life in happiest manner with leadership skills.

TEXT BOOKS

1. Life Skills for Engineers, McGraw Hill Education (India) Private Ltd., 2016.
2. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015.

REFERENCES

1. Barun K. Mitra; (2011), "Personality Development & Soft Skills", 1st Edition; Oxford Publishers.
2. Kalyana; (2015) "Soft Skill for Managers"; 1st Edition; Wiley Publishing Ltd.

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SEMESTER II

19HST201	COMMUNICATIVE TECHNO ENGLISH – II	L T P C
	(Common to all departments)	3 0 0 3

OBJECTIVES

To enable students to:

- Acquire usage of grammar in English language.
- Enhance the reading skill to comprehend technical writing.
- Improve business writing skills.
- Develop presentation skills in analytical view.
- Help learners to develop their speaking skills and speak fluently in real contexts

UNIT I: GRAMMAR   9

Compound words - prepositions- articles- conditionals - Direct and indirect speeches-subject verb agreement-active and passive voice.

Activity: Grammar worksheets on the given topics.

UNIT II: LANGUAGE ENHANCEMENT THROUGH LISTENING & READING   9

Syllabification - sentence stress - Intonation - Listening to You Tube Documentaries- Reading Vocabulary-Reading News Papers- Reading short stories.

Activity: Playing video & TED and identifying stress and intonation.

UNIT III: BUSINESS WRITING   9

Writing Recommendations - Checklist- Business Letters - Calling for Quotations, Placing Orders, Letter of Complaint, Letter of Clarification - Cover Letter with Résumé- Report Writing - Accident Report, Industrial Visit Report, Survey Report and Feasibility Report.

Activity: Giving topic and ask the students to prepare checklist and complaint.

UNIT IV: WRITING   9

Transcoding Graphics - Bar Chart, Flow Chart, Pie Chart and Tables- - Tour Itinerary - Process Description- Agenda and Minutes of meeting.

Activity: Giving charts to the students and ask them to transcode.

UNIT V: SPEAKING   9

Collaborative task - Turn taking (initiating and responding appropriately) - Negotiating - Exchanging - suggesting - comparing and contrasting - expressing - Finding out facts, attitudes and opinions - Commonly mispronounced words.

TOTAL: 45 PERIODS

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OUTCOMES

Upon completion of the course, the students will be able to:

- Acquire advanced level grammatical knowledge.
- Improve their language usage in LSRW skills.
- Enhance the writing skills to express the ideas in the business context
- Acquire the ability to understand different written texts.
- Categorize a wide range of vocabulary and English usage.

TEXT BOOKS

1. S. Sumant Maven Learning, "Technical English II" January 2011

2. KN Shoba, Lourdes Joavani Rayen "Communicative English" Cambridge university 2017

REFERENCES

1. Dr K Elango, Dr. Veena Selvam, Dr. Sujatha Priyadarshini, "Resonance English for Engineers and Technologists".Cambridge University Press, 1st Edition, Foundation Books,New Delhi, 2013.

2. Seely, John. Oxford Guide to Effective Writing and Speaking. Indian ed. New Delhi: Oxford University Press. 2005.

E-RESOURCES

1. https://nptel.ac.in/courses/109/104/109104031/- (Verbal and Non Verbal Communication)
2. https://nptel.ac.in/courses/109/106/109106094/ - (Technical English for Engineers)

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19CYT201	**ENVIRONMENTAL SCIENCE AND ENGINEERING**	**L T P C**
	(Common to all departments)	**3 0 0 3**

OBJECTIVES

To enable students to:

- Explain the importance of the environment, concepts of ecosystem and overview of biodiversity and its conservation.

- Summarize the causes, effects and control of the various environmental pollution.

- Describe about natural resources and resource management.

- Assess the social issues to improve the quality of environment.

- Analyze the causes of population explosion, importance of value education and relation between human health and environment.

UNIT I   ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY   11

Definition, scope and importance of environment - need for public awareness - concept of an ecosystem - structure and function of an ecosystem - producers, consumers and decomposers food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (C) desert ecosystem (d) aquatic ecosystems (ponds, rivers, oceans) - Introduction to biodiversity definition: genetic, species and ecosystem diversity - biogeographical classification of India - value of biodiversity India as a mega-diversity nation - hot-spots of biodiversity- threats to biodiversity - endangered and endemic species of India - conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

Activity: Biodiversity in and around the campus and report submission.

UNIT II   ENVIRONMENTAL POLLUTION   9

Definition - causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards - solid waste management: causes, effects and control measures of municipal solid wastes - e-waste - role of an individual in prevention of pollution - pollution case studies - disaster management: floods, earthquake and cyclone.

Activity: Local Pollution Case Study and report submission.

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UNIT III   NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, dams and their effects on forests and tribal people - Water resources: Use and over- utilization of surface and ground water,

floods, drought, conflicts over water, dams-benefits and problems - Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies - Food resources: World food problems, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies - Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies - Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification - role of an individual in conservation of natural resources.

Activity: Waste to wealth.

UNIT IV   SOCIAL ISSUES AND THE ENVIRONMENT 9

From unsustainable to sustainable development - water conservation, rain water harvesting, watershed management - resettlement and rehabilitation of people; its problems and concerns, case studies - environmental ethics: Issues and possible solutions - climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. - wasteland reclamation - Green Chemistry and principles - environment production act - Air (Prevention and Control of Pollution) act - Water (Prevention and control of Pollution) act - Wildlife protection act - Forest conservation act - Public awareness.

Activity: Creating Environmental Awareness.

UNIT V   HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations - population explosion - family welfare programme - environment and human health - human rights - value education - HIV / AIDS - women and child welfare - role of information technology in environment and human health - Case studies.

Activity: Visit to local primary health center.

TOTAL: 45 PERIODS

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OUTCOMES

Upon completion of the course, the students will be able to:

- Discuss about the features of various ecosystems and need of conservation of biodiversity.
- Apply the appropriate methodologies to control the various environmental pollution.
- Get the knowledge about the different types of resources like land, water, mineral and energy and also about the effects of environment by the usage of these resources.
- Assess the social issues to improve the quality of environment and participating actively in solving current environmental problem.
- Find solution for the effects of the population explosion as well as environmental and human health issues.

TEXT BOOKS

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, NewDelhi, 2006.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.

REFERENCES

1. Erach Bharucha, 'Textbook of Environmental Studies', Universities Press(I) Pvt Ltd,Hydrabad, 2015.
2. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India Pvt Ltd, New Delhi, 2007

E-RESOURCES

1. https://nptel.ac.in/courses/122102006/ - (Nature of Environment)
2. https://nptel.ac.in/courses/127/105/127105018/- (Sustainability Concepts)

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19MAT201	ENGINEERING MATHEMATICS - II	L T P C
	(Common to all departments)	3 1 0 4

OBJECTIVES

The Course objectives are to:

- Acquire sound knowledge of techniques in solving ordinary differential equations obtained from engineering problems.

- Acquaint the student with the concepts of vector calculus that is needed for problems in engineering disciplines.

- Develop the fundamental concepts in analytic functions, conformal mapping and Bilinear transformations.

- Extend the standard techniques of complex integration.

- Compose the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I: DIFFERENTIAL EQUATIONS   9+3

Higher order linear differential equations with constant coefficients - Method of variation of parameters – Homogenous equation of Euler's and Legendre's type - System of simultaneous linear differential equations with constant coefficients.

UNIT II: VECTOR CALCULUS   9+3
Gradient and directional derivative - Divergence and curl – Line integral over a plane curve – Surface integral – Area of a curved surface – volume integral – Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals

UNIT III: ANALYTIC FUNCTIONS   9+3

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates – Properties – Harmonic conjugates – Construction of analytic function – Conformal mapping – Mapping by function $w = \frac{1}{z}$ – Bilinear transformation.

UNIT IV: COMPLEX INTEGRATION   9+3

Cauchy's integral theorem - Cauchy's integral formula - Laurent's series -   Application of residue theorem for evaluation of real integrals - Use of circular contour and semicircular contour.

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UNIT V: LAPLACE TRANSFORMS   9+3

Existence conditions - Transforms of elementary functions - Transform of unit step function and unit impulse function - Basic properties - Shifting theorems -Transforms of derivatives and integrals - Inverse transforms - Convolution theorem - Transform of periodic functions- Application to solution of linear second order ordinary differential equations with constant coefficients.

TOTAL: 45+15=60 PERIODS

OUTCOMES

After successfully completing the course, the student will have a good understanding of the following topics and their applications

- Apply various techniques in solving differential equations which arises in engineering problems.
- Solve engineering problems using the concept of vector calculus.
- Develop the concept of analytic functions, conformal mapping and Bilinear transformation..
- Evaluate integrals using Cauchy's integral formula and residual theorem.
- Build the Laplace transforms techniques in solving differential equation.

TEXT BOOKS

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015.

REFERENCES

1. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, Delhi, 10th Edition, New 2016.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.

E-RESOURCES

1. https://nptel.ac.in/courses/111/105/111105134/ - (Vector Functions)
2. https://nptel.ac.in/courses/122/107/122107036/ - (Complex Integration)

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19MDT201   **MEDICAL PHYSICS**   **L T P C**

3 0 0 3

OBJECTIVES

The main objectives of this course are to :

- Provide understanding of the application of the radiation concepts and methods of Physics in Medical science
- Accentuate the principle, effects and clinical applications of ionizing, non-ionizing and electromagnetic radiation.
- Enunciate the fundamentals of acoustic waves and their interaction with human tissues.
- Explore the effects of radiation in matter and how isotopes are produced
- Study effects of sound and light in human body.
- Inculcate medical physics knowledge to innovate medical application devices.

UNIT I LOW ENERGY ELECTROMAGNETIC SPECTRUM AND ITS MEDICAL APPLICATION   9

Physics of light, Intensity of light, limits of vision and color vision an overview, Non-ionizing Electromagnetic Radiation: Overview of non-ionizing radiation effects-Tissue as a leaky dielectric-Low Frequency Effects- Higher frequency effects., Thermograph– Application

UNIT II PRINCIPLES OF RADIOACTIVE NUCLIDES   9

Radioactive Decay – Spontaneous Emission – Isometric Transition – Gamma ray emission, alpha, beta, Positron decay, electron capture, Sources of Radioisotopes Natural and Artificial radioactivity, Radionuclide used in Medicine and Technology, Production of radio nuclides – Laser Applications in medical field.

UNIT III INTERACTION OF RADIATION WITH MATTER LIPIDS   9

Interaction of charged particles with matter –Specific ionization, Linear energy transfer range, Bremsstrahlung, Annihilation, Interaction of X and Gamma radiation with matter-Photoelectric effect. Compton Scattering, Pair production, Attenuation of Gamma Radiation, Interaction of neutron withmatter and their clinical significance

UNIT IV RADIATION DOSE AND ITS EFFECTS   9

Dose and Exposure measurements – Units (SI), Inverse square law, Maximum permissible exposure, relationship between the Dosimetric quantities, Radiation biology – effects of radiation, concept of LD50, Stochastic and Non-stochastic effects, Radiation Syndrome..

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UNIT V PRINCIPLES AND APPLICATIONS OF SOUND IN MEDICINE   9

Physics of sound, Normal sound levels, ultrasound fundamentals, Generation of ultrasound (Ultrasound Transducer), Interaction of Ultrasound with matter- Cavitations, Reflection, Transmission, Scanning methods, Artifacts, Ultrasound- Doppler effect, Clinical Applications

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of this course, the students will be able to:

- Interpret the properties of electromagnetic radiations and its effect on human
- Apply the principles and understand the production of radioactive nuclides
- Explain the interaction of radiation with matter..
- Identify and Analyse the radiation quantities and its effects
- Demonstrate the knowledge on the properties of sound and its application in medicine.
- Innovate medical application devices by incorporating knowledge of medical physics.

TEXT BOOKS

1. The need for physical facility for Body is Rajendran V. "Engineering Physics". Tata McGraw Hill Publications, 2012.

2. Gopal B. Saha - Physics and Radiobiology of Nuclear Medicine Fourth edition Springer, 2006

REFERENCES

1. W.J. Meredith and J.B. Massey "Fundamental Physics of Radiology" Varghese Publishing house, Third Edition, 2013.

2. Steve Webb, The Physics of Medical Imaging, Taylor & Francis, Newyork, Second Edition, 2012.

E-RESOURCES

1. https://nptel.ac.in/courses/102105090. (Introduction to Biomedical Imaging Systems)

2. https://nptel.ac.in/courses/115106087 (Nuclear Reactors and Safety- An Introduction, IIT Madras)

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19GEE201	**BASICS OF ELECTRICAL MACHINES**	L T P C
	(Lab Embedded Theory Course)	3 0 2 4

OBJECTIVES

To enable the students to:

- Introduce the fundamental concepts and operation of DC machines.

- Deliberate the working of single phase and three phase transformers.

- Know the principle of operation and performance of synchronous machines.

- Understand construction, principle of operation and performance of induction motors.

- Describe construction, principle of operation and working of special electrical machines.

- Compare and animate the different types of motor characteristics for the utilization in medical instrumentation.

UNIT I: DC MACHINES   9

DC GENERATORS: Principle of operation, constructional details, armature windings and its types, EMF equation, armature reaction, OCC and load characteristics of different types of DC Generators. **DC MOTORS:** Principle of operation, Types of DC motor, significance of back emf, torque equations and power developed by armature, starting methods of DC motors, load characteristics of DC motors, speed control of DC motors.

UNIT II: SINGLE PHASE AND THREE PHASE TRANSFORMER   9

Construction and principle of operation, equivalent circuit, phasor diagrams, voltage regulation, losses and efficiency, all day efficiency, applications of single-phase transformer. Construction and working of auto transformer, applications of autotransformer. Three Phase Transformer-Construction, types of connections.

UNIT III: SYNCHRONOUS MACHINES   9

Synchronous Generator: Introduction, Constructional details – Types of rotors –winding factors-EMF equation – Synchronous reactance – Armature reaction. Voltage regulation – EMF, MMF method,Synchronous Motor: Principle of operation – Starting methods- V and Inverted V curves.

UNIT IV: THREE PHASE AND SINGLE PHASE INDUCTION MOTOR   9

Constructional details – Types of rotors –- Principle of operation – Slip –Torque-Slip characteristics - Condition for maximum torque – Load test - Types of starters- Speed control-Constructional details of single phase induction motor – Double field revolving theory and operation- Starting methods of single-phase induction motors.

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UNIT V: SPECIAL ELECTRICAL MACHINES   **9**

Linear induction motor – Repulsion motor - Hysteresis motor - AC series motor- Servo motors- Stepper motors - Switched Reluctance Motors (SRM)-Permanent Magnet Brushless DC Motor- introduction to magnetic levitation systems.

LIST OF EXPERIMENTS

(Any Eight Experiments to be conducted)

1. Open circuit characteristics of DC shunt generator
2. Load characteristics of DC shunt generator
3. Load test on DC shunt motor.
4. Load test on DC series motor.
5. Speed Control of DC Shunt motor
6. Load test on single-phase transformer
7. Open circuit and short circuit tests on single phase transformer.
8. Regulation of three phase alternator by EMF and MMF methods
9. Load test on three-phase induction motor.
10. Load test on single-phase induction motor

                 TOTAL: 45+15=60 PERIODS

OUTCOMES

Upon completion of this course, the students can able to:

- Explain the construction, working principle and various characteristics of DC machines.
- Describe the working principle of single phase and three phase transformer with different types of connections.
- Understand the construction and working principle of Synchronous Machines.
- Gain knowledge about the basic principles, working and starting of Three phase and Single phase induction motors.
- Gain knowledge about the basic principles, working of special electrical machines.
- Animate and select the appropriate type of motor for medical instrumentation.

TEXT BOOKS

1. P. S. Bimbhra, "Electric Machinery", Khanna Publishers, 2nd Edition, 2021.
2. D.P. Kothari and I.J. Nagrath, 'Electric Machines', McGraw Hill Publishing Company Ltd, 5th Edition 2017

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REFERENCES

1. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2018.

2. K.Venkataratnam, 'Special Electrical Machines', Universities Press (India) Private Limited, 2008.

E-RESOURCES

1. https://youtu.be/OiscWFfO08s- (Electrical Machines)

2. https://youtu.be/cv2L7CfBYrA- (Special Electrical Machines)

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19MDE201	ELECTRONIC DEVICES AND CIRCUITS	L T P C
	(Lab Embedded Theory Course)	3 0 2 4

OBJECTIVES

To enable students to:

- Understand the structure of basic electronic devices.
- Be exposed to active and passive circuit elements.
- Familiarize the operation and applications of transistor like BJT and FET
- Explore the characteristics of amplifier gain and frequency response
- Learn the required functionality of positive and negative feedback systems
- Simulate and compare the result of various electronic devices and circuits.

Unit I: PN JUNCTION DEVICES   **9**

PN junction diode –structure, operation and V-I characteristics, diffusion and transition capacitance - Rectifiers – Half Wave and Full Wave Rectifier,– Display devices- LED, Laser diodes, Zener diode characteristics- Zener Reverse characteristics – Zener as regulator.

UNIT II: TRANSISTORS AND THYRISTORS   **9**

BJT, JFET, MOSFET- structure, operation, characteristics and Biasing UJT, Thyristors and IGBT - Structure and characteristics..

UNIT III: AMPLIFIERS   **9**

BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response – MOSFET small signal model– Analysis of CS and Source follower – Gain and frequency response- High frequency analysis.

UNIT IV: MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER   **9**

BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response – Neutralization methods, power amplifiers –Types (Qualitative analysis).

UNIT V: FEEDBACK AMPLIFIERS AND OSCILLATORS   **9**

Advantages of negative feedback – voltage / current, series , Shunt feedback –positive feedback – Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

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LIST OF EXPERIMENTS

(Any Eight Experiments to be conducted)

1. Characteristics of PN Junction Diode
2. Zener Diode Characteristics & Regulator using Zener diode
3. Common Emitter input-output Characteristics of BJT
4. Common Base input-output Characteristics of BJT.
5. FET Characteristics.
6. SCR Characteristics.
7. Clipper and Clamper & FWR.
8. Characteristics of Photo Diode.
9. Characteristics of Photo Transistor.
10. Characteristics of LED & LCD.

TOTAL: 45+15=60 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Identify and differentiate both active and passive elements
- Explain the structure and working operation of basic electronic devices.
- Analyze the characteristics of different electronic devices such as diodes and transistors
- Employ the acquired knowledge in design and analysis of oscillators
- Choose and adapt the required components to construct an amplifier circuit.
- Simulate the working of electronic devices and circuits for the effective utilization in medical field.

TEXT BOOKS

1. Millman and Halkias, "Electronic Devices and Circuits", 4th Edition, McGraw Hill, 2015.
2. Mohammad Rashid, "Electronic Devices and Circuits", Cengage Learning Pvt. Ltd, 2015

REFERENCES

1. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory" PearsonPrentice Hall, 11th Edition, 2014.
2. Bhattacharya and Sharma, "Solid State Electronic Devices", 2nd Edition, Oxford UniversityPress, 2014.

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E-RESOURCES

1. https://youtu.be/VSUOFdMN00E- (Electronic Devices and Circuit Theory)
2. https://youtu.be/SC1kpLGyK-w- (Solid State Electronic Devices)

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19EEC203	HANDS ON TRAINING IN	L T P C
	ELECTRICAL AND ELECTRONICS ENGINEERING	0 0 2 0

(Employability Enhancement Course)
(For EEE,MDE and ECE Branches)

OBJECTIVES

To Enable the Students to:

- Gain practical experience on Electrical Appliances.

- Create awareness on non-conventional energy.

LIST OF EXPERIMENTS:

1. Maintenance of UPS and Battery.

2. Earthing of Power Devices.

3. Repair & Maintenance of Home Appliances.

4. Change of Fuse Links.

5. Repair & Maintenance of Air Compressor.

6. Repair & Maintenance of RO System (filter, pump motor).

7. Study of Electronic Devices.

8. Residential house wiring using switches, fuse, indicator, lamp and energy meter.

9. Fluorescent lamp wiring.

10. Stair case wiring.

11. Soldering practice-components devices and circuits-using general purpose PCB.

TOTAL: 20 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Repair and service the electrical appliances.

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SEMESTER III

19MAT301   TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS   L T P C
(Common to CSE, ECE, MDE and EEE Branches)   **3 1 0 4**

OBJECTIVES:

To enable the students to:

- Discover the basic concepts of Partial differential equation for solving standard partial differential equations.

- Apply the Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.

- Acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.

- Explain Fourier transform techniques used in wide variety of situations.

- Utilize the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I: PARTIAL DIFFERENTIAL EQUATIONS   9+3

Formation of partial differential equations - Singular integrals - Solutions of standard types of first order partial differential equations - Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of homogeneous types.

UNIT II: FOURIER SERIES   9+3

Dirichlet's conditions - General Fourier series - Odd and even functions - Half range Sine and Cosine series - Parseval's identity - Harmonic analysis.

UNIT III: APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS   9+3

Classification of partial differential equations - Method of separation of variables - Fourier Series Solutions of one dimensional wave equation - One dimensional equation of heat conduction - Steady state solution of two dimensional equation of heat conduction.

UNIT IV: FOURIER TRANSFORMS   9+3

Statement of Fourier integral theorem - Fourier transforms pair - Fourier sine and cosine Transforms - Properties - Transforms of simple functions - Convolution theorem -Parseval's identity.

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UNIT V: Z - TRANSFORMS AND DIFFERENCE EQUATIONS   **9+3**

Z-transforms - Elementary properties - Inverse Z-transform (using partial fraction and residues)
Initial and final value theorems - Convolution theorem - Solution of difference equations using Z
- transform.

TOTAL: 45+15=60 PERIODS

OUTCOMES:

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

- Use the standard types of partial differential equations.
- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
- Relate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
- Analyze some of the physical problems of engineering by Fourier transforms.
- Apply Z transforms techniques in solving difference equation.

TEXT BOOKS

1. Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, New Delhi, 2014.
2. Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics forEngineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 2012.

REFERENCES

1. N.P. Bali and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2014.
2. Erwin Kreyszig, "Advanced Engineering Mathematics",10th Edition, John Wiley, India, 2016.

E - RESOURCES

1. https://nptel.ac.in/courses/111/105/111105035/ (Review Groups, Fields and Matrices)
2. https://nptel.ac.in/courses/111105035/27 (Complex Variables)

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19MDT301   **ANATOMY AND HUMAN PHYSIOLOGY**   **L T P C**
                                                                3 1 0 4

OBJECTIVES

The student should be made to:

- Understand the basic elements of human body.
- Integrate the individual functions of all the cells and tissues and organs into functional whole, the human body.
- Know the structural dependency and functional anatomy of the organs.
- Emphasizes on the cardiovascular, respiratory, urinary and nervous system and theirinterrelatedness.
- Understand the basic functioning of every system and the resultant   unified organization.
- Simulate the working of different human parts for the better understanding of their functions.

UNIT I: BASIC ELEMENTS OF HUMAN BODY   9+3

Cell — Cell Structure and organelles - Functions of each component in the cell. Cell membrane — transport across membrane - Action potential (Nernst, Goldman equation), Homeostasis. Tissue: Types, functions.

UNIT II: SKELETAL AND MUSCULAR SYSTEM   9+3

Skeletal: Types of Bone and function – Physiology of Bone formation – Division of Skeleton - Types of joints and function — Types of cartilage and function. –Types of muscles — Structure and Properties of Skeletal Muscle- Changes during muscle contraction-Neuromuscular junction.

UNIT III: CARDIOVASCULAR AND RESPIRATORY SYSTEM   9+3

Cardiovascular System: Structure – Conduction System of heart – Cardiac Cycle – **Cardiac** output. Blood: Composition – Functions - Haemostasis – Blood groups and typing. Blood Vessels – Structure and types - Blood pressure - Respiratory system: Parts of respiratory system – Respiratory physiology – Lung volumes and capacities – Gaseous exchange.

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UNIT IV: DIGESTIVE AND EXCRETORY SYSTEMS   **9+3**

Structure and functions of gastrointestinal system - secretion functions of the alimentary tract - digestion and absorption in the gastrointestinal tract - structure of nephron - mechanism of urine formation - skin and sweat gland - temperature regulation.

UNIT V: NERVOUS AND SENSORY SYSTEM   **9+3**

Structure and function of nervous tissue – Brain and spinal cord – Functions of CNS – Nerve conduction and synapse – Reflex action– Somatic and Autonomic Nervous system. Physiology of Vision, Hearing, Integumentary, Olfactory systems. Taste buds.

LIST OF EXPERIMENTS
(Any Eight Experiments to be conducted)

1. Hearing test
2. Visual Acuity
3. BMI Test
4. Lung capacity Test (Manual & Digital)
5. Body Temperature Measurements (Invasive & non Invasive)
6. Design the model of any one Functional system of Human Body
7. Cardio Vascular Test
8. Identification Joints ,bones , tissues, Arteries, veins
9. Neuro Muscular stimulation & Function Test
10. Blood Pressure Test

TOTAL: 45+15=60 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to:

- Identify and explain basic elements of human body
- Explain the functions of skeletal and muscular system
- Describe the structure, function of cardiovascular system and respiratory system
- Discuss the structure of digestive and excretory system
- Elaborate the physiological process of Nervous and sensory system.
- Simulate the working of different parts of human body.

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TEXT BOOKS

1. Elaine.N. Marieb, "Essential of Human Anatomy and Physiology", Ninth Edition, Pearson Education, New Delhi, 2018.

2. Atheena Milagi Pandian S, 'Human Anatomy & Physiology' – First Edition, International Notion Publishers, 2019

REFERENCES

1. Guyton & Hall, "Text book of Medical Physiology", 13th Edition, Saunders, 2015.

2. Ranganathan T S, "Text book of Human Anatomy", S.Chand& Co. Ltd., New Delhi, 2012.

E-RESOURCES

1. https://youtu.be/aqxuezBzxcg - (Essential of Human Anatomy and Physiology)

2. https://www.digimat.in/nptel/courses/medical/anatomy/AN11.html (Kidneys)

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19EET304	CIRCUIT THEORY	L T P C
		3 1 0 4

OBJECTIVES

The student should be made to:

- Understand the basic concepts of DC and AC circuits behavior.
- Impart knowledge on solving circuit equations using network theorems.
- Introduce the phenomenon of resonance and coupled circuits.
- Educate on obtaining the transient response of circuits and analysis of two port networks.
- Familiarize the network topologies.

UNIT I: BASIC CIRCUITS ANALYSIS   **9+3**

Ohm's Law - Kirchoffs laws - DC and AC Circuits - Resistors in series and parallel circuits - Network reduction: voltage and current division - Source transformation - Star delta conversion - Mesh current and node voltage method of analysis for D.C and A.C. circuits.

UNIT II: NETWORK THEOREMS FOR DC AND AC CIRCUITS   **9+3**

Network theorems : Superposition theorem - Thevenin's theorem - Norton's theorem - Reciprocity theorem - Millman's theorem   -   Maximum power transfer theorem   - Application of Network theorems.

UNIT III: RESONANCE AND COUPLED CIRCUITS   **9+3**

Series and parallel resonance - Frequency response - Quality factor and Bandwidth - Self and mutual inductance - Dot rule - Coefficient of coupling - Tuned circuits - Single tuned circuits.

UNIT IV: TRANSIENT RESPONSE ANALYSIS AND TWO PORT NETWORKS   **9+3**

Natural response - Forced response - Transient response of RC, RL and RLC circuits to excitation by Step Signal, Impulse Signal and exponential sources - Two port networks - Z parameters - Y parameters - Hybrid(H) Parameters - Transmission (ABCD) parameters.

UNIT V: NETWORK TOPOLOGY   **9+3**

Network terminology - Graph of a network - Tree - Co tree - Incidence and reduced incidence matrices - Cutsets - Fundamental cutsets - Cutset matrix - Tie sets - Link currents and Tie set schedules - Twig voltages and Cutset schedules - Duality and dual networks.

TOTAL : 45+15=60 PERIODS

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OUTCOMES:

Upon Completion of the course, the students will be able to:

- Understand and evaluate DC ad AC electrical circuits
- Develop the capacity to apply the circuit theorems in real time
- Acquire the knowledge about resonance and coupled circuits
- Analyze the concepts in transients and two port networks
- Design the network topologies

TEXT BOOKS

1. William H. Hayt, Jr. Jack E. Kemmerly and Steven M. Durbin, 'Engineering Circuit Analysis', McGraw Hill Science Engineering, Eighth Edition, 11th Reprint 2012.
2. Charles K. Alexander, Mathew N.O. Sadiku, 'Fundamentals of Electric Circuits', 6th, Tata McGraw Hill,2019.

REFERENCES

1. Chakrabati A, 'Circuits Theory (Analysis and synthesis)', Dhanpath Rai & Sons, NewDelhi, 2018.
2. Sudhakar A and Shyam Mohan SP, 'Circuits and Networks: Analysis and Synthesis', Tata McGraw Hill, 2015.

E-RESOURCES

1. www.nptel.in/courses/108/105/108105159/ (Network Analysis)
2. www.nptel.in/courses/117/106/117106108/ (Basic Electrical Circuits)

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19ECE301	DIGITAL ELECTRONICS	L T P C
	(Lab Embedded Theory Course)	3 0 2 4

OBJECTIVES

The student should be made to:

- Introduce basic postulates of Boolean algebra and shows the correlation between Boolean expressions and methods for simplifying Boolean expressions.
- Outline the formal procedures for the analysis and design of combinational circuits.
- Interpret the formal procedures for the analysis and design of sequential circuits.
- Identify the concept of memories and programmable logic devices.
- Illustrate the concept of synchronous and asynchronous sequential circuits.
- Simulate and implement logic circuits using gates and verilog.

UNIT I: DIGITAL FUNDAMENTALS   9

Number Systems - Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes - Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine-McCluskey method of minimization.

UNIT II: COMBINATIONAL CIRCUIT DESIGN   9

Half and Full Adders, Half and Full Subtractors, Binary Design of Half Parallel Adder - Carry look ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder,Priority Encoder, Verilog HDL for combinational circuits.

UNIT III: SYNCHRONOUS SEQUENTIAL CIRCUITS   9

Flip flops - SR, JK, T, D, Master/Slave FF - operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits - Design - Moore/Mealy models, state minimization, state assignment, circuit implementation - Design of Counters- Ripple Counters, Ring Counters, Shift registers, Universal Shift Register.

UNIT IV: ASYNCHRONOUS SEQUENTIAL CIRCUITS   9

Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits, ASM chart.

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UNIT V: MEMORY DEVICES AND DIGITAL INTEGRATED CIRCUITS   9

Basic memory structure - ROM -PROM - EPROM - EEPROM - EAPROM, RAM - Static and dynamic RAM -Programmable Logic Devices - Programmable Logic Array (PLA) Programmable Array Logic (PAL)   - Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using PLA, PAL.

LIST OF EXPERIMENTS

1. Verification of Boolean theorems using digital logic gates.
2. Design and implementation of combinational circuits using basic gates for arbitrary functions, code converters, etc.
3. Design and implementation of 4-bit binary adder / subtractor using basic gates and MSI devices.
4. Design and implementation of parity generator / checker using basic gates and MSI devices.
5. Design and implementation of magnitude comparator.
6. Design and implementation of application using multiplexers/ Demultiplexers.
7. Design and implementation of Shift registers.
8. Design and implementation of Synchronous and Asynchronous counters.
9. Design and implementation of MOD/Ring counters.
10. Simulation of combinational circuits and sequential circuits using Hardware Description Language (VHDL/Verilog HDL software required)
11. Design and implementation of a simple digital system (Mini Project).

TOTAL: 45+15=60 PERIODS

OUTCOMES

Students will be able to:

- Analyze different methods used for simplification of Boolean expressions.
- Design and implement Combinational circuits.
- Design and implement synchronous and asynchronous sequential circuits.
- Write simple HDL codes for the circuits.
- Use the semiconductor memories and related technology.
- Develop combinational circuits, sequential circuits using logic gates and verilog.

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TEXT BOOK

1. M. Morris R. Mano, Michael D. Ciletti, —Digital Design: With an Introduction to the VerilogHDL, VHDL, and System Verilogll, 6thEdition, Pearson Education, 2017.

2. Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011.

REFERENCE

1. G. K. Kharate, Digital Electronics, Oxford University Press, 2010.

2. John F. Wakerly, Digital Design Principles and Practices, 5th Edition, Pearson Education,2017

E-RESOURCES

1. https://nptel.ac.in/courses/117/106/117106086/ (Digital Circuits and Systems)

2. https://nptel.ac.in/courses/108/105/108105132/ (Digital Electronic Circuits)

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19MDE301   **BIOSCIENCES & BIO ANALYZERS**   **L T P C**
                      (Lab Embedded Theory Course)   **3 0 2 4**

OBJECTIVES

The student should be made to:

- Understand the fundamental concepts of biochemistry.
- Study structural and functional properties of carbohydrates, proteins, lipids and amino acids
- Emphasize the role of these biomolecules by providing basic information on specific metabolic diseases and disorders of these biomolecules.
- Gain knowledge on the structural and functional aspects of living organisms.
- Know the etiology and remedy in treating the pathological diseases.
- Direct best bio analyzer for the medical applications.

UNIT I: FUNDAMENTALS TO BIOCHEMISTRY   9

Introduction to Biochemistry, water as a biological solvent, weak acid and bases, pH, buffers, Handerson - Hasselbalch equation, physiological buffers in living systems, Energy in living organism. Properties of water and their applications in biological systems. Introduction to Biomolecules, Biological membrane.

UNIT II: CARBOHYDRATES, LIPIDS, PROTEIN   9

Classification of carbohydrates - polysaccharides. Structure, physical and chemical properties of carbohydrates - Classification of lipids- simple, compound, and derived lipids. Nomenclature of fatty acid - Structure and properties of proteins, structural organization of proteins, classification and properties of amino acids. Nucleic acid: Structural aspects- Components of DNA and RNA, Nucleosides & Nucleotides (introduction, structure & bonding), Double helical structure of DNA (Watson-Crick model), various forms of DNA

UNIT III: CELL DEGENERATION, REPAIR AND NEOPLASIA   9

Cell injury - Reversible cell injury and Irreversible cell injury and Necrosis, Apoptosis, Intracellular accumulations, Pathological calcification- Dystrophic and Metastatic. cellular adaptations of growth and differentiation, Inflammation and Repair including fracture healing, Neoplasia, Classification, Benign and Malignant tumours, carcinogenesis, spread of tumours Autopsy and biopsy.

UNIT IV: FLUID AND HEMODYNAMIC DERANGEMENTS   9

Edema, Hyperemia/Ischemia, normal hemostasis, thrombosis, disseminated intravascular coagulation, embolism, infarction, shock, Chronic venous congestion. Hematological disorders- Bleeding disorders, Leukaemias, Lymphomas Haemorrhage..

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UNIT V: FUNDAMENTALS OF MICROBIOLOGY AND IMMUNOPATHOLOGY   9

Structure of Bacteria and Virus - Morphological features and structural organization of bacteria and virus - List of common bacterial, fungal and viral diseases of human beings.- Basics of Microscopes : Light microscope, Electron microscope (TEM & SEM). - Natural and artificial immunity, types of Hypersensitivity, antibody and cell mediated tissue injury, Immunological. techniques: immune diffusion, immuno electrophoresis, RIA and ELISA, monoclonal antibodies.

LIST OF EXPERIMENTS

1. Preparation of solutions: 1) percentage solutions, 2) molar solutions, 3) normal solutions
2. Standardization of pH meter, preparation of buffers, emulsions.
3. Spectroscopy: Determination of absorption maxima (λmax) of a given solution
4. Preparation of serum and plasma from blood
5. Separation of proteins by SDS electrophoresis (Demo) and amino acids by thin layer chromatography (Demo).
6. Types of Staining : Simple stain, Gram stain
7. Measurement of blood sugar & hemoglobin in blood
8. Collection of Blood Samples & Identification of Blood groups
9. Estimation of RBC ,WBC & BTCT
10. Analysis of Urine Sample

TOTAL: 45 +15=60 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to :

- Explain the fundamentals of biochemistry.
- Articulate structural and functional properties of carbohydrates, proteins, lipids and aminoacids
- Analyze structural and functional aspects of living organisms.
- Evaluate the function of microscope.
- Describe methods involved in treating the pathological diseases.
- Devise best bio analyzer for medical applications.

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TEXT BOOKS

1. RAFI MD "Text book of biochemistry for Medical Student" Fourth Edition, Universities Press, Orient Blackswan Private Limited - New Delhi 2021.

2. Ramzi S Cotran, Vinay Kumar & Stanley L Robbins, "Pathologic Basis of Diseases", 10th edition: South Asia Edition Elsevier India, 2020. (Units III & IV)

3. Ananthanarayanan & Panicker, "Microbiology" Orientblackswan, 2017 10th edition. (UnitsIII,IV and V)..

REFERENCES

1. Keith Wilson & John Walker, "Practical Biochemistry - Principles & Techniques", Oxford University Press, 2009.

2. Prescott, Harley and Klein, "Microbiology", 10th edition, McGraw Hill, 2017.

E-RESOURCES

1. https://youtu.be/ld3A065dELc- (General and Systematic Pathology)

2. https://youtu.be/Yh9w_fyvpUk- (Pathologic Basis of Diseases)

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19CSE303	DATA STRUCTURES USING C	L T P C
	(Lab Embedded Theory Course)	3 0 2 4

OBJECTIVES:

The student should be made to:

- Learn the features of C.
- Analyze and differentiate the linear and non-linear data structures.
- Explore the applications of linear and non-linear data structures.
- Understand to represent data using graph data structure.
- Know the basic sorting and searching algorithms.
- Write various application programs using key data structure concepts.

UNIT I: C PROGRAMMING BASICS   9

Structure of a C program - Constants, Variables - Data Types - Expressions using operators in C - Managing Input and Output operations - Decision Making and Branching - Looping statements. Arrays - Strings- String operations. Simple programs - sorting- searching – matrix operations.

UNIT II: FUNCTIONS, POINTERS, STRUCTURES AND UNIONS   9

Functions - Pass by value - Pass by reference - Recursion - Pointers - Definition - Initialization - Pointers arithmetic. Structures and unions - Structure within a structure and Unions - Storage classes, Pre-processor directives.

UNIT III: LINEAR DATA STRUCTURES   9

Arrays and its representations - Stacks and Queues - Linked lists - Linked list-based implementation of Stacks and Queues and its operations(Insert, Traverse and Delete) - Evaluation of Expressions - Linked list based polynomial addition.

UNIT IV: NON-LINEAR DATA STRUCTURES   9

Trees - Binary Trees - Binary tree representation and traversals - Binary Search Trees and its operations - Applications of trees. Set representations - Union-Find operations. Graph and its representations - Graph Traversals Techniques.

UNIT V: SEARCHING AND SORTING ALGORITHMS   9

Linear Search - Binary Search. Bubble Sort, Insertion sort - Merge sort - Quick sort – Heap Sort -Hash tables - Overflow handling.

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LIST OF EXPERIMENTS

1. Basic C Programs - looping, data manipulations and arrays.
2. Programs using strings - String function implementation.
3. Programs using structures and pointers.
4. Programs involving dynamic memory allocations.
5. Array implementation of stacks.
6. Array Implementation of circular queue.
7. Linked list implementation of stacks and queues.
8. Application of stacks and queues.
9. Implementation of Trees, Tree Traversals.
10. Implementation of Binary Search trees.
11. Implementation of Linear search and binary search.
12. Implementation Insertion sort, Bubble sort, Quick sort and Merge Sort.
13. Implementation Hash functions, collision resolution technique.

TOTAL: 45 +15=60 PERIODS

OUTCOMES:

Upon completion of the course, students will be able to:

- Understand the basic concepts of C programming.
- Implement linear and non-linear data structure operations using C.
- Suggest appropriate linear / non-linear data structure for any given data set.
- Apply hashing concepts for a given problem.
- Analyse and select a data structure for an application.
- Appropriately choose the sorting algorithm for an application.

TEXT BOOKS:

1. Pradip Dey and Manas Ghosh, ―Programming in C, 2nd Edition, Oxford University Press, 2015.
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, ―Fundamentals of Data Structures in C, 2nd, University Press, 2017.

REFERENCES:

1. Mark Allen Weiss, ―Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education, 1996.
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, ―Data Structuresand Algorithms, Pearson Education, 1983.

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E-RESOURCES

1. https://nptel.ac.in/courses/106/104/106104128/ (Introduction to Programming in C)
2. https://nptel.ac.in/courses/106/105/106105164/ (Introduction to Algorithms and Analysis)

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19EEC301	COMMUNICATION SKILLS	L T P C
		0 0 2 0

OBJECTIVES:

The purpose of learning this course is to:

- Improve fluency in English through well developed vocabulary.
- Improve the oral communication skills.
- Focus the effective reading of general and technical text.
- Improve writing skill.
- Communicate ideas in group discussion and interviews.

UNIT I: VOCABULARY   6

Vocabulary building - articulate ideas and thoughts; usage of palindromes,greetings, wishes, festival related words - homophones and homonyms- connotation - vocabulary words with sentences. - Idiomatic Expressions - One- word Substitutes.

Activities: Learn a word a week, Use newspaper to write unfamiliar words, Word association games.

UNIT II: LISTENING   6

Listening Skill- Its importance - Purpose- Process- Types- Barriers- Effective Listening strategies- Listening and note-taking - Listening to telephonic conversations - Ted talks - Watching Inspiring Speech videos on You tube- Listening native speaker's videos for pronunciation.

Activities: Listen and draw the different scenes in a story, Secret Message games,watching videos and listing difficult words.

UNIT III: SPEAKING   6

JAM Talk - Role play - Debate - Conversational skills (formal and informal) - Conversation practice - group discussion and interview skills - Introducing oneself and others - Presentation skills -Making presentations (individual and group) through seminars / PPTs.

Activities: Picture Description, Giving Directions and Guidelines, Making a short speech - Extempore.

UNIT IV: READING   6

Strategies for effective reading (Guessing meanings from contexts -Scanning, skimming,inferring meaning and critical reading)- Read and recognize different text types ranging from newspaper articles, magazines, books, Technical articles and Reading autobiographies.

Activities: Reading online sources like e-books, e-journals and e-newspapers, cloze exercises,

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Reading and answering questions.

UNIT V: WRITING 6

Develop a paragraph: topic sentence, supporting sentences, concluding sentence - Writing simple Essays - argument, descriptive and comparative essays- Creative writing.

Activities: Write Essays with sub titles, Write a story that uses as many clichés and idioms, Write Paragraph.

TOTAL : 30 PERIODS

The following Practice Session will be conducted for the Communication Skills (CS) Lab sessions:

- Activities on Presentations Skills- Students make presentations on given topics.
- Activities on Group Discussion- Students participate in group discussions.
- Interview Skills- Students participate in Mock Interviews.
- Essay Writing - Students prepare their own paragraph and essay.

Guidelines for conducting assessments as per 2019 regulations

- 30 hours - Two consecutive hours allotted for each class.
- Three Continuous assessments only conducted and no end semester exam.
- For the award of Continuous assessment the best three activities from Essay Writing, Oral Presentation, Extempore, Group Discussion and Mock Interview(one-on-one basis) can be taken.

OUTCOMES:

At the end of this course, learners will be able to:

- Improve vocabulary and express the same contextually.
- Communicate to his peer group properly and make presentations.
- Comprehend the general and technical text.
- Write simple paragraph and essay in any topic.
- Participate in group discussions expressing ideas relevantly, coherently and cogently.

TEXT BOOKS:

1. Gramer F. Margot and Colin S. Ward Reading and Writing (Level 3) Oxford University .Press:Oxford, 2011.

2. Brooks,Margret. Skills for Success. Listening and Speaking. Level 4 Oxford UniversityPress, Oxford: 2011.

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REFERENCES:

1. Davis, Jason and Rhonda LIss. Effective Academic Writing (Level 3) Oxford University Press: Oxford, 2006.
2. E. Suresh Kumar and et al. Enriching Speaking and Writing Skills. 2nd Edition. Orient Black swan.
3. Anderson, Kenneth et al. Study Speaking: A Course in Spoken English for Academic Purposes. United Kingdom: Cambridge University Press 1992.
4. Technical communication by Asraf rezvi.

E- RESOURCES :

1. www.youglish.com
2. www.Newwellington University.com
3. www.newsinlevels.com
4. www.Britishcouncil.org
5. www.writeandimprove.com
6. www.purdueonline.com

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19MDC301	**LEADERSHIP ENHANCEMENT PROGRAMME**	**L T P C**
	(Common to all branches)	**1 0 0 0**

OBJECTIVES

The objective of the course is enabling the students to:

- Find new, innovative ways of developing and managing people.

- Develop new business opportunities.

- Tackle the broader societal issues the face.

- Key benefits of leadership skills in different situations.

- Formulate and implement effective leadership strategies.

TOIPICS TO BE COVERED

1. Leadership for an Engineering students: Skills & Strategies

2. Qualities of good leaders and 21 irrefutable laws of Leadership.

3. Empowering Others and Managing People.

4. Leading Meetings

5. Leadership competencies and Leadership Styles

6. Difference between a boss and a leader.

7. Leadership and Assertiveness Skills: A Good Leader, Leadership Theories, Leadership Behaviour, Assertiveness skills.

8. Leadership development opportunities and suggestions.

9. Teamwork and Leadership: Concept of teams, Building Effective teams, Concept of leadership and sharpening leadership skills.

10. Teamwork and Leadership Activities: Group discussion, Solving Puzzle as a team, describing a leadership style.

OUTCOMES

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

- Develop the capabilities needed to increase team's work productivity.

- Help to decrease employee turnover and increase engagement, creating a strong and united team.

- Develop communication skills, mastering the art of negotiation, influence and conflict management.

- More confident as a leader and find new ways of influencing the teams they lead.

- Effectively connect to people, developing the ability to give constructive feedback, and critically seek the feedback of the team.

TOTAL: 12 PERIODS

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TEXT BOOK

1. John maxwell, "21 irrefutable laws of leadership" 2008

2. Sara n. King, David g. Altman, Robert j. Lee, "Discovering the leader in you"

3. Louis carter ,David ulrich , Marshall Goldsmith "Best practices in leadership development and Organization change".

REFERENCE

1. Barry Benator, Albert Thumann, "Project Management and Leadership Skills for Engineering and Construction Projects" 2003.

2. Sydänmaanlakka Pentti. "Intelligent leadership and leadership competencies". Dissertation Series.

E-RESOURCES

1. https://nptel.ac.in/courses/122/105/122105021/

2. www.ccl.org/leadership/research/index.aspx.

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SEMESTER IV

19MDT401　　　　　　　**HUMAN ASSIST DEVICES**　　　　　　**L P T C**
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　3 0 0 3

OBJECTIVES

The student should be made to:

- Know the principle, design and application of various human assist devices and aids.
- Elaborate the cardiac assist devices.
- Understand the design aspects of prosthetic and orthotic devices.
- Analyze the different visual aids.
- Examine the operation of various hearing and speech aids.
- Create new human assist devices for medical engineering applications.

UNIT I:　CARDIAC ASSIST DEVICES　　　　　　　　　　　　　　　9

CARDIAC ASSIST DEVICES- Synchronous counter pulsation, assisted through respiration right ventricular by-pass pump, left ventricular bypass pump, open chest and closed chest type, Principle and problems --Intra Aortic balloon pumping, Veno Arterial Pumping, Prosthetic Cardio Valves, Biomaterials for purposes, its characteristics and testing, Pacemaker

UNIT II:　PROSTHETIC AND ORTHOTIC DEVICES　　　　　　　　9

PROSTHESIS INTRODUCTION

Incidence and Epidemiology- Rehabilitation of an Amputee- Problems in Stump- Immediate Postoperative Prosthetic Fitting- Prosthesis in Foot and Ankle Amputation, Hand and Arm replacement – Different Types of Models, Externally Powered Limb Prosthesis, Introduction to Orthosis- Functions of an Orthosis- Cervical Orthosis- Upper Limb Orthosis- Lower Limb Orthosis- Foot Wear Modifications- Feedback in Orthotic System, Functional Electrical Stimulation, Materials for Prosthetic and Orthotic devices

UNIT III:　VISUAL AIDS　　　　　　　　　　　　　　　　　　　9

Ultrasonic and laser canes, Intra ocular lens, Braille Reader, Tactile devices for visually Challenged, Text to voice converter, Screen readers. Ophthalmology Devices - Bionic eye – Contact Lenses.

UNIT IV:　HEARING AND SPEECH AIDS　　　　　　　　　　　　9

Audiograms, types of deafness - conductive and nervous, hearing aids- Types, constructional andfunctional characteristics. Cochlear implants- Need, constructional details, speech trainer.

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UNIT V: REHABILITATION MEDICINE AND ADVOCACY   9

Physiological aspects of Function recovery, Psychological aspects of Rehabilitation therapy, Legal   aspect available in choosing the device and provision available in education, job and in day-to-day life

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, students will be able to:

- Know the role and importance of assist devices.
- Explain the functions of cardiac assist devices.
- Illustrate the design aspects of prosthetic and orthotic devices.
- Compare and understand the functions of different visual aids.
- Analyze the various hearing and speech aids.
- Design new human assist devices for the medical engineering applications.

TEXT BOOKS

1. Rory A Cooper, An Introduction to Rehabilitation Engineering, Taylor & Francics ,CRC Press,2006.
2. Joseph D.Bronzino, The Biomedical Engineering Handbook, Third Edition: Three VolumeSet, CRC Press, 2006.

REFERENCES

1. Short Textbook of Prosthetics and Orthotics- R Chinnathurai- Jaypee Brothers Medical Publishers (P) Ltd-2010
2. R.S. Khandpur, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, 2 nd Edition,Edition- 2003.

E-RESOURCES

1. https://archive.nptel.ac.in/noc/courses/noc21/SEM1/noc21-me52/ (Mechanics of Human Movement)
2. https://youtu.be/bgpwPB22Ap0 - (Artificial Organs)

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19MDT402	CONTROL SYSTEMS FOR MEDICAL ENGINEERS	L T P C
		3 1 0 4

OBJECTIVES

The objective of this course is to enable the student to:

- Understand the concept behind feedback and continuum in various systems and subsystems and the need for mathematical modeling of various systems.
- Analyze the systems in time and frequency domains.
- Understand the concept of stability of various systems.
- Evaluate the concept of frequency response analysis.
- Apply mathematical modeling principles in understanding the various fundamental biological systems.
- Collaborate the knowledge in biological control systems to innovate new ideas in medical fields,

UNIT I: INTRODUCTION   9+3

Open and Closed loop Systems, Mathematical Modeling of systems, Block diagram and signal flow graph representation of systems - reduction of block diagram and signal flow graph, Introduction to Physiological control systems- Illustration, Linear models of physiological systems, The Transfer Functions and Block diagram analysis physiology- Difference between engineering and physiological control systems.

UNIT II: TIME RESPONSE ANALYSIS   9+3

Step and impulse responses of first order and second order systems - time domain specifications of first and second order systems - steady state error constants.

UNIT III: STABILITY ANALYSIS   9+3

Definition of stability, Routh- Hurwitz criteria of stability, Root locus technique - construction of root locus and study of stability

UNIT IV: FREQUENCY RESPONSE ANALYSIS   9+3

Frequency domain specifications - Polar plots - Bode plots - Nyquist plot - Nyquist stability criterion, closed loop stability - Constant M and N circles - Nichol's chart.

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UNIT V: BIOLOGICAL CONTROL SYSTEM ANALYSIS   9+3

Simple models of muscle stretch reflex action - steady state analysis of muscle stretch reflex action, transient response analysis of neuromuscular reflex model action, frequency response of circulatory control model, The pupil control systems(Human Eye),Dynamic response characterisitics of pupil control system, Stability analysis of Pupillary light reflex.

TOTAL: 45+15=60 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

* Interpret the need for mathematical modeling of various systems, representation of systemsin block diagrams and signal flow graphs and are introduced to biological control systems.

* Determine the time response of various systems

* Discuss the concept of system stability**.**

* Examine the frequency response characteristics of various systems using different charts

* Appraise the concept of modeling basic physiological systems.

* Create innovative ideas in medical field using the knowlwdge of biological control systems.

TEXT BOOKS

1. I.J. Nagarath and M. Gopal, "Control Systems Engineering", New Age International Publishers, 1st September, 2018.

2. Michael C K Khoo, "Physiological Control Systems", IEEE Press, Prentice Hall India, 2005.

REFERENCES

1. Salivahanan S. Rengaraj R. and Venkatakrishnan G. R., " Control Systems Engineering",Pearson Education India, 2015.

2. Ogata, Katsuhiko and Yanjuan Yang, "Modern control engineering", Vol 4, Prentice-Hall, 2002

E-RESOURCES

1. https://nptel.ac.in/courses/108/101/108101037/ (Control Engineering)

2. https://www.youtube.com/watch?v=RgbXo_jHAXY (Biomedical Control Systems)

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19MDT403	BIO SENSORS AND MEASUREMENTS	L T P C
		3 0 0 3

OBJECTIVES

The student should be made to :

- Understand the purpose of measurements and characteristics.
- Know the principle of transduction, classification and the characteristics of transducers.
- Gain knowledge on photoelectric and piezo electric sensors.
- Analyze the different bridges for measurement.
- Examine the different display and recording devices.
- Simulate the functions of different biosensors.

UNIT I: SENSOR BASED MEASUREMENT SYSTEM   9

Generalized measurement system- Sensor classification- Static characteristics- Dynamic characteristics- Primary sensors and materials for sensor .

UNIT II: DISPLACEMENT, PRESSURE AND TEMPERATURE SENSORS   9

Strain Gauge: Gauge factor- Sensing elements- Bonded and Unbonded strain gauge, Capacitive transducer , Inductive transducer, LVDT ,Pressure transducer , Temperature Sensors: Passive type: RTD materials and range- Relative resistance versus temperature characteristics- Characteristics of Thermistor, Active type: Characteristics of Thermocouple, Case Study: Sensors for Environmental monitoring.

UNIT III: PHOTOELECTRIC AND PIEZO ELECTRIC SENSORS   9

Phototube - Scintillation counter - Photo multiplier tube - Photovoltaic - Photo conductive cells - Photo detector-Phototransistor - Comparison of photoelectric transducers, Optical displacement sensors, Piezoelectric active transducer: Piezo electric force sensors,Piezo electric pressure sensors,Equivalent circuit and its characteristics, Case study: Optical sensors for diagnosis - Oxygen Saturation monitor..

UNIT IV: SIGNAL CONDITIONING CIRCUITS   9

Functions of signal conditioning circuits — Preamplifiers, Concepts of passive filters, Impedance matching circuits, AC and DC Bridges: Wheat stone, Kelvin, Maxwell, Hay, Schering.

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UNIT V: DISPLAY AND RECORDING DEVICES   9

Digital voltmeter, Multimeter , CRO: Block diagram , CRT , Vertical & horizontal deflection system, DSO, LCD monitor , PMMC writing systems , Servo recorders , Photographic recorder , Magnetic tape recorder , Inkjet recorder , Thermal recorder.

TOTAL: 45 PERIODS

OUTCOMES

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

- Measure various electrical parameters with accuracy, precision, resolution.
- Select appropriate passive or active transducers for measurement of physical phenomenon.
- Analyze the functions of various photoelectric and piezo electric sensors.
- Use AC and DC bridges for relevant parameter measurement.
- Employ multimeter, CRO, and recorders for appropriate measurements.
- Simulate and Compare functionality of different biosensors and measurements.

TEXT BOOKS

1. A.K.Sawhney , "Electrical & Electronics Measurement and Instrumentation", Dhanpat Rai &Co, New Delhi, 2017..
2. John G. Webster, "Medical Instrumentation Application and Design", Wiley India Pvt Ltd, New Delhi, 2020.

REFERENCES

1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2015..
2. Albert D.Helfrick, William D. Cooper , "Modern Electronic Instrumentation and MeasurementTechniques", Prentice Hall of India, New Delhi, 2016.

E-RESOURCES

1. https://nptel.ac.in/courses/108/105/108105153/ (Electrical Measurements and Electronic Instrument)
2. https://nptel.ac.in/courses/108/108/108108147/ (Sensors And Actuators)

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19ECT301 **SIGNALS AND SYSTEMS** **L T P C**
3 1 0 4

OBJECTIVES:

The student should be made to:

- Understand the basic properties of signal & systems.
- Know the methods of characterization of LTI systems in time domain.
- Analyze continuous time signals and system in the Fourier and Laplace domain.
- Educate discrete time signals in the Fourier and laplace transform.
- Examine discrete time system in the Z transform domain.

UNIT I: CLASSIFICATION OF SIGNALS AND SYSTEMS **9+3**

Standard signals-Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids,Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & A periodic signals,Deterministic & Random signals, Energy & Power signals-Classification of systems- CT systems and DT systems - Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.

UNIT II: ANALYSIS OF CONTINUOUSTIMESIGNALS **9+3**

Fourier series for periodic signals - Complex Fourier Series- Fourier Transform - properties-Laplace Transforms and properties.

UNIT III: LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS **9+3**

Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in Analysis of CT systems - Systems connected in series / parallel.

UNIT IV: ANALYSIS OF DISCRETETIME SIGNALS **9+3**

Baseband signal Sampling - Sampling theorem - Fourier Transform of discrete time signals (DTFT) - Properties of DTFT - Z Transform & Properties.

UNIT V: LINEAR TIME INVARIANT-DISCRETETIMESYSTEMS **9+3**

Impulse response - Difference equations-Convolution sum- Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel.

TOTAL: 45+15 =60 PERIODS

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OUTCOMES

Upon completion of the course, the students will be able to:

- Determine if a given system is linear/causal/stable

- Capable of determining the frequency components present in a deterministic signal.

- Develop characterizing LTI systems in the time domain and frequency domain.

- Compute the output of an LTI system in the time and frequency domains.

- Analyze the Recursive & Non-Recursive systems of Z Transform.

TEXT BOOKS

1. Allan V.Oppenheim,S.Wilsky and S.H.Nawab,- Signals and Systemsǁ, Pearson,2015

2. B.P. Lathi,- Principles of Linear Systems and Signalsǁ, 2nd Edition,Oxford,2009.

REFERENCES

1. R.E.Zeimer, W.H.Tranter and R.D.Fannin, - Signals & Systems - Continuous and Discreteǁ, Pearson, 2007.

2. John Alan Stuller, - An Introduction to Signals and Systems, Thomson, 2007

E-RESOURCES

1. https://nptel.ac.in/courses/117/101/117101055 (Signals and Systems)

2. https://nptel.ac.in/courses/108/104/108104100/ (Principles of Signals and System)

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19MDE401	MEDICAL INSTRUMENTATION	L T P C
	(Lab Embedded Theory Course)	3 0 2 4

OBJECTIVES

The student should be made to:

- Gain knowledge on basic concepts of medical instrumentation
- Understand about bio potential electrodes and amplifiers.
- Perform the basic measurements of physiological parameters.
- Know about medical equipment design and developments.
- Conceptualize about the design and development of biological devices.
- Bring some innovative ideas on new biomedical devices.

UNIT I: BASIC CONCEPTS OF MEDICAL INSTRUMENTATION   9

BASIC CONCEPTS OF MEDICAL INSTRUMENTATION:

Terminology of medicine and medical devices, generalized medical instrumentation system, alternative operational modes, medical measurement constraints-classification of biomedical instruments-biostatistics-regulations of medical devices

BIO POTENTIAL:

Origin of bio potential and its propagation. Electrode–skin interface, half cell potential. Types of electrodes and its application. Recording problems - measurement with two electrodes.

UNIT II: ELECTRODE CONFIGURATIONS & BIO AMPLIFIER   9

Biosignals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode.

BIO AMPLIFIER: Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier, isolation amplifiers — transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier, Instrumentation Amplifier

UNIT III: MEASUREMENTS OF BLOOD PRESSURE,BLOOD VOLUME AND CARDIAC OUTPUT   9

BLOOD PRESSURE: direct and indirect measurements-harmonic analysis of blood pressure waveforms-heart sounds-phonocardiography - **Blood volume**: electromagnetic flow meters-ultrasonic flow meters-chamber plethysmography-photo plethysmography.

CARDIAC OUTPUT MEASUREMENTS: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.

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UNIT IV: CLINICAL LABORATORY INTRUMENTS 9

Blood gas and acid base Physiology –Electro chemical sensor chromatology - electrophoresis - Blood cell counter, Auto analyzer, Centrifuge, Blood gas analyzers, colorimeter, flame photometer, spectrophotometer.

UNIT V: DESIGN AND DEVELOPMENT OF BIOMEDICAL DEVICES AND SYSTEMS 9

The Essentials of Design -Overview- Biomedical Engineering Design in Industrial Context- Fundamental Design Tools- Product Definition- Product Development- Hardware Development Methods and Tools- Software Development Methods and Tools- Biomaterials and Material Testing- Biological Engineering Designs

Developing Biomedical Devices- Emerging Issues in Healthcare- Innovation and Rights- Industrial Designs- Patent Classification- Examples of Industrial Design Requirements Evaluations

LIST OF EXPERIMENTS

1. Simple Op Amp Circuit Measurements
2. Design and analysis of biological pre amplifiers
3. Blood pressure measurement
4. Recording of ECG signal and EEG analysis
5. Recording of EMG-Signal
6. Recording of various physiological parameters using patient monitoring system and telemetry units.
7. Measurement of respiration rate.
8. Measurement and recording of peripheral blood flow
9. Study of Dialyzer
10. Study of Defibrillator
11. Measurement of PH and Conductivity
12. Measurement of Blood Glucose

TOTAL: 45+15=60 PERIODS

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OUTCOMES

Upon completion of the course, the students will be able to:

- Explain the fundamental concepts of medical instrumentation.
- Perform Electrical and non-electrical physiological measurements.
- Evaluate the function of bio amplifiers.
- Analyze the functions of laboratory and radiological equipments.
- Elaborate about medical equipment designing procedure.
- Design new biomedical instruments.

TEXT BOOKS

1. Medical Instrumentation: Application and Design- by John G. Webster-john wiley & sons-inc,2009-fourth edition.

2. Design of Biomedical Devices and Systems, Third Edition- Paul H. King, Richard C. Fries,Arthur T. Johnson- CRC Press-2014.

REFERENCES

1. Developing Biomedical Devices-Design, Innovation and Protection.by Andreoni, Giuseppe,Barbieri, Massimo, Colombo, Barbara-poliMi springer briefs-2014.

2. Medical Instruments and Devices: Principles and Practices by Steven Schreiner, Joseph D.Bronzino, Donald R. Peterson- CRC Press –first edition -2017.

E - RESOURCES

1. https://www.egr.msu.edu/classes/ece445/mason/Files/2-Basics_ch1.pdf (Medical Instrumentation: Application and Design)

2. https://youtu.be/2aqJ5wYuvfQ (Developing Biomedical Devices-Design)

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19ECE402	LINEAR INTEGRATED CIRCUITS	L T P C
	(Lab Embedded Theory Course)	3 0 2 4

OBJECTIVES

The main objective of this course is to:

- Understand the basic building blocks of linear integrated circuits.
- Learn the linear and non-linear applications of operational amplifiers.
- Analyze the theory and applications of analog multipliers and PLL.
- Realization of ADC and DAC using Op-Amp.
- Introduce the concepts of waveform generation and introduce some special function ICs.
- Use SPICE software for circuit design.

UNIT I: OPERATIONAL AMPLIFIER FUNDAMENTALS   9

Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, Basic information about op-amps - Ideal Operational Amplifier - General operational amplifier stages -and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations - JFET Operational Amplifiers - LF155 and TL082.

UNIT II: APPLICATIONS OF OPERATIONAL AMPLIFIERS   9

Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters.

UNIT III: ANALOG MULTIPLIER AND PLL   9

Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable transconductance technique, analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, Applications of PLL.

UNIT IV: ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS   9

Performance Specifications - D-A Conversion Techniques - Weighted Resistor DACs - R-2RLadders - Current Mode R-2R Ladder - Voltage Mode R-2R Ladder - Multiplying DAC Applications - A-D Conversion Techniques - Successive Approximation Converters - Flash Converters - Integrating Type Converters - Over Sampling Converters.

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UNIT V: WAVEFORM GENERATORS AND VOLTAGE REGULATORS   9

Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555, IC Voltage regulators - Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator, Low Drop - Out(LDO) Regulators

LIST OF EXPERIMENTS

1. Inverting, Non inverting and differential amplifiers.
2. Design of Integrator and Differentiator using Op-amp.
3. Design of Differential amplifier to find CMRR using Op-amp.
4. Design of Instrumentation amplifier.
5. Design of Low pass and High pass filters using Op-amp.
6. Design of Astable and Monostable multivibrator using Op-amp.
7. Design of Schmitt triggers using Op-amp.
8. Phase shift and Wien bridge oscillators using Op-amp.
9. Design of Monostable and Astable multivibrators using IC 555.
10. DC power supply using LM317 and LM723.
11. Simulation of Active low-pass, High-pass and band-pass filters using Op-amp
12. Simulation of Analog Multiplier.
13. Simulation of Astable and Monostable multivibrator using Op-amp.

TOTAL : 45+15=60 PERIODS

OUTCOMES

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

- Study the basic building block of Linear Integrated circuits.
- Design linear and non linear applications of OP - AMPS.
- Incorporate applications using analog multiplier and PLL.
- Construct ADC and DAC using Op –Amps.
- Generate waveforms using Op-Amp Circuits.
- Design and simulation of Op-Amp circuits using SPICE software.

TEXT BOOKS

1. D.Roy Choudhry, Shail Jain, ―Linear Integrated Circuits‖, New Age International Pvt. Ltd., 2018, 5th Edition.
2. Sergio Franco, ―Design with Operational Amplifiers and Analog Integrated Circuits‖, 4th Edition, Tata Mc Graw-Hill, 2016.

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REFERENCES

1. Ramakant A. Gayakwad, ―OP-AMP and Linear ICs‖, 4th Edition, Prentice Hall /Pearson Education, 2015.

2. Robert F.Coughlin, Frederick F.Driscoll, ―Operational Amplifiers and Linear Integrated Circuits‖, 6th Edition, PHI, 2001.

E-RESOURCES

1. https://nptel.ac.in/courses/108/108/108108111/ (Integrated Circuits, MOSFETS OP-AMPS and their Applications ,)

2. https://nptel.ac.in/courses/117/106/117106030/(Analog IC Design)

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19EEC401	ENTREPRENEURSHIP DEVELOPMENT ACTIVITY	L T P C
	(Common to all Branches)	0 0 2 0

OBJECTIVES

The course objectives can make students to:

- Evaluate social and civil responsibilities of business ownership.

- Describe typical behavioral characteristics of an effective entrepreneur.

- Develop a business plan, including identifying an executive summary; conducting a marketing and competitive analysis report; and developing a marketing, management, and financial plan.

- Determine career opportunities, responsibilities, and educational and credentialing requirements related to various entrepreneurship ventures.

- Interpret research data to determine market-driven problems faced by entrepreneurs.

TOPICS TO BE COVERED

1. Should You Become an Entrepreneur?

- Entrepreneurship: Present & Past

- Is Entrepreneurship Right for You

- Identify Business Opportunities & Set Goals

2. What Skills Do Entrepreneurs Need

- Communication Skills

- Math Skills

- Problem Solving Skills

3. Entrepreneurs in a Market Economy

- What is an Economy?

- The Concept of Cost

- Government in a Market Economy

4. Select a Type of Ownership

- Run an Existing Business

- Own a Franchise or Start a Business

- Choose the Legal Form of Your Business

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ESTD 2001

5. Develop a Business Plan

    - Why Do You Need a Business Plan

    - What Goes into a Business Plan

    - Create an Effective Business Plan

6. Identify and Meet a Market Need

    - The Value of Market Research

    - How to Perform Market Research Entrepreneurship Syllabus

    - Identify Your Competition

7. Finance, Protect, and Insure Your Business

    - Put Together a Financial Plan

    - Obtain Financing for Your Business

    - Protect Your Business

8. Choose Your Location & Set Up for Business

    - Choose a Retail Business Location

    - Choose a Location for a Nonretail Business

    - Obtain Space and Design the Physical Layout

    - Purchase Equipment, Supplies, and Inventory

9. Market Your Business

    - The Marketing Mix

    - Product, Price, Distribution, Price, and Promotion

    - Set Marketing Goals

10. Hire and Manage a Staff

    - Hire Employees

    - Create a Compensation Package

    - Manage your Staff

11. Record-Keeping and Accounting

    - Set up a Record Keeping System

    - Understand Basic Accounting

    - Track Your Inventory

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12. Financial Management

- Manage your Cash Flow
- Analyze Your Financial Performance
- Hire Experts

13. Use Technology

- Technology and Your Business
- Learn about the Interest
- Purchase Technology

14. Intellectual property Rights

- Patents
- Copyright
- Industrial design rights
- Trademarks
- Trade secrets

15. Innovation Contest

- Innovative Idea
- Proof of Concept (PoC)
- Prototype Creation
- The students may be grouped into 2 to 3 and work under a project supervisor. The Prototypes to be fabricated may be decided in consultation with the supervisor. A innovative report to be submitted by the group and the model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department.

OUTCOMES

- Identify personal strengths and value systems.
- Recall important tenets of digital literacy.
- Discuss the essentials of matters pertaining to money.
- Prepare for employment and self-employment.
- Illustrate the basics of entrepreneurship and identify new business opportunities.

TOTAL: 15 PERIODS

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19MDC401   **VALUE ADDED COURSE – I**   **LT P C**
                                                                       - - - -

OBJECTIVES

- Being able to carry out simple numerical computations and analyses using MATLAB.
- The objective of the course makes students capable to design their own projects PCB upto industrial grade.
- To prepare students with trouble shooting of ICU,IP & OP equipments
- The purpose of the course is to help circuit designers better understand the operation of a LABVIEW

ANY ONE COURSE IN THE LIST:

1. **MATLAB**
2. **PCB DESIGN & TRUOBLE SHOOTING**
3. **TESTING & CALIBARATION OF MEDICAL EQUIPMENTS WITH INTERNATIONAL MEDICAL STANDARDS & REGULATIONS**
4. **LABVIEW FOR MEDICAL APPLICATIONS .**
5. **MACHINE LEARNING AND AI**

OUTCOMES

At the end of this course, the students are able to:

- Write simple programs in MATLAB to solve scientific and mathematical problems.
- Design PCB of their own circuit.
- Repair and Diagnose the Problem of all kinds of faults in ICU,IP & OP equipments as well as Software and rectify the faults with standard testing & Calibration methods
- Analyze simple analog and digital circuits for medical applications using LABVIEW software.

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SEMESTER V

19MDT501   DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS   L T P C

3 0 0 3

OBJECTIVES

The student should be made to:

- Understand the medical equipment used in the measurement of parameters related to cardiology and neurology

- Understand the principle of respiratory measurement, patient monitoring and biotelemetry.

- Understand the function of various extracorporeal devices.

- Understand Biomedical diathermy, ultrasound, Laser principles and applications.

- Understand the various sensory measurements that hold clinical importance.

UNIT I: CARDIAC AND NEURO MUSCULAR EQUIPMENT   9

Electrocardiograph, Heart rate monitor, Holter Monitor, Cardiac Pacemaker – types, AC & DC Defibrillator, types, Precautions. EEG, Evoked Potential –Visual, Auditory and Somatosensory, Psychophysiological Measurements for testing sensory Responses, MEG (Magneto Encephalograph). Recording and analysis of EMG, NCV measurement, EGG (Electro Gastro Graph), MMG (Magneto Myo Graph).

UNIT II: RESPIRATORY MEASUREMENT, PATIENT MONITORING AND BIOTELEMETRY9

Spirometer, pneumotachometer, Whole body plethysmography. Apnea Monitor, Types of Ventilators, Humidifiers, Nebulizers, Inhalators. Patient monitoring systems - ICU/CCU Equipments. Architecture of Biotelemetry system – types. Concept of m-Health 2.0, Point of care devices — disposable hematology sensors.

UNIT III: EXTRA CORPOREAL DEVICES AND SPECIAL DIAGNOSTIC TECHNIQUES   9

Need for heart lung machine, Functioning of bubble, Disc type and membrane type oxygenators, finger pump, roller pump. Hemodialyser unit, Peritoneal dialyser unit, Wearable artificial kidney. Lithotripsy, Cryogenic technique, Thermography — Recording Principle and clinical application.

UNIT IV: DIATHERMY, ULTRASOUND AND LASER BASED EQUIPMENTS   9

IR and UV lamp - application. Need for different diathermy units. Electro surgery machine. Ultrasound - Basic principles of Echo technique, display techniques A, B and M mode, B Scan, Application of ultrasound as diagnostic tool. Lasers in Medicine — Types, Tissue reactions. Lasers in ophthalmology, Flow Cytometry, Endoscopy, Minimally Invasive Laparoscopy, Laser Microirradiation, Laser Doppler Velocimetry, Neurosurgical Laser

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Techniques.

UNIT V: SENSORY DIAGNOSTIC EQUIPMENT   9

Psychophysiological Measurements – polygraph, basal skin resistance (BSR), galvanic skin resistance (GSR), Sensory responses - Audiometer-Pure tone, Speech, Eye Tonometer, Applanation Tonometer, slit lamp, auto refractometer.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Apply different medical devices in the measurement of parameters related to cardiology,neurology
- Perform continuous monitoring and transmission of vital parameters.
- Comprehend the need for special diagnostic and therapeutic devices and extra-corporealdevices.
- Appreciate the use of advanced laser technology in diagnosis and minimally invasive therapies.
- Describe the measurement techniques of sensory responses.

TEXT BOOKS

1. John G. Webster, "Medical Instrumentation Application and Design", 4th edition, Wiley IndiaPvtLtd,New Delhi, 2015.
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson education, 2012.

REFERENCES

1. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", 3rd Edition,2008.
2. Khandpur. R.S.,"Handbook of Biomedical Instrumentation". Second Edition. TataMcGrawHill Pub. Co.,Ltd. 2003.

E-RESOURCES

1. https://youtu.be/yRPKNplZdS4
2. https://youtu.be/wNrRN3HV6nY

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19MDT502   **BIOMATERIALS AND ARTIFICIAL ORGANS**   **L T P C**
                                                              3 0 0 3

OBJECTIVES

The student should be made to:

- Learn characteristics and classification of Biomaterials.
- Understand different metals, ceramics and its nanomaterials characteristics as biomaterials.
- Learn polymeric materials and combinations that could be used as a tissue replacementimplants.
- Have an overview of artificial organs & transplants.
- Study about soft tissue replacement and hard tissue replacement.

UNIT I: INTRODUCTION TO BIO-MATERIALS   9

Definition and classification of bio-materials, mechanical properties, visco elasticity, biomaterial performance, body response to implants, wound healing, blood compatibility, nanoscale phenomena.

UNIT II: METALLIC AND CERAMIC MATERIALS   9

Metallic implants - Stainless steels, co-based alloys, Ti-based alloys, shape memory alloy, nanostructured metallic implants, degradation and corrosion, ceramic implant — bioinert, biodegradable or bioresorbable, bioactive ceramics, nanostructured bioceramics.

UNIT III: POLYMERIC IMPLANT MATERIALS   9

Polymerization, factors influencing the properties of polymers, polymers as biomaterials, biodegradable polymers, Bio polymers: Collagen, Elastin and chitin. Medical Textiles, Case study of organ regeneration.

UNIT IV: ARTIFICIAL ORGANS & TRANSPLANTS   9

ARTIFICIAL ORGANS: Introduction, outlook for organ replacements, design consideration, evaluation process.

TRANSPLANTS: Overview, Immunological considerations, Blood transfusions, individual organs – kidney, liver, heart and lung, bone marrow, cornea.

UNIT V: IMPLANTABLE MEDICAL DEVICES AND ORGANS   9

Gastrointestinal system, Dentistry, Maxillofacial and craniofacial replacement, Soft tissue repair, replacement and augmentation, recent advancement and future directions..

TOTAL: 45 PERIODS

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OUTCOMES

Upon completion of this course, the students should be able to:

- Analyze different types of Biomaterials and its classification.

- Identify different metals, ceramics and its nanomaterials characteristics as biomaterials.

- Perform combinations of materials that could be used as a tissue replacement implant.

- Gain adequate knowledge about artificial organs & transplants.

- Know the different types of soft tissue replacement and hard tissue replacement.

TEXT BOOKS

1. Sujata V. Bhatt, —Biomaterials, Second Edition, Narosa Publishing House, 2005.

2. Sreeram Ramakrishna, Murugan Ramalingam, T. S. Sampath Kumar, and Winston O. Soboyejo, —Biomaterials: A Nano *Approach*‖, CRC Press, 2010.

REFERENCES

1. Myer Kutz, —Standard Handbook of Biomedical Engineering & Design‖ McGraw Hill, 2003.

2. J D Bronzino, Biomedical Engineering handbook Volume II, (CRC Press / IEEE Press), 2000.

E-RESOURCES

1. https://www.digimat.in/nptel/courses/video/102106057/L01.html

2. https://onlinecourses.nptel.ac.in/noc19_mm24/preview

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19ECE502	**DIGITAL SIGNAL PROCESSING**	**L T P C**
	(Lab Embedded Theory Course)	**3 0 2 4**

OBJECTIVES

The student should be made to:

- Learn the Discrete Fourier transform and its properties.
- Understand the characteristics of digital IIR Filters.
- Analyze the concept of digital FIR Filters.
- Characterize the effects of quantization in digital filters.
- Implement the signal processing algorithms in Digital signal Processor.
- Perform basic signal processing operations such as Convolution, Correlation, Filteringand Frequency analysis in MATLAB.

UNIT I: DISCRETE FOURIER TRANSFORM   9

Discrete Fourier transform (DFT) - deriving DFT from DTFT, properties of DFT - periodicity, symmetry, circular convolution. Linear filtering using DFT. Filtering long data sequences - overlap save and overlap add method. Fast computation of DFT - Radix-2 Decimation-in-time (DIT) Fast Fourier transform (FFT), Decimation-in-frequency (DIF) Fast Fourier transform (FFT). Linear filtering using FFT.

UNIT II: INFINITE IMPULSE RESPONSE FILTERS   9

Characteristics of practical frequency selective filters. characteristics of commonly used analog filters - Butterworth filters, Chebyshev filters. Design of IIR filters from analog filters (LPF, HPF, BPF, BRF) - Approximation of derivatives, Impulse invariance method, Bilinear transformation. Frequency transformation in the analog domain. Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations.

UNIT III: FINITE IMPULSE RESPONSE FILTERS   9

Design of FIR filters - symmetric and Anti-symmetric FIR filters - design of linear phase FIR filters using Fourier series method - FIR filter design using windows (Rectangular, Hamming and Hanning window), Frequency sampling method. FIR filter structures - linear phase structure, direct form realizations.

UNIT IV: FINITE WORD LENGTH EFFECTS   9

Fixed point and floating point number representation - ADC - quantization - truncation and rounding - quantization noise - input / output quantization - coefficient quantization error – product quantization error - overflow error - limit cycle oscillations due to product quantization andsummation - scaling to prevent overflow.

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UNIT V: INTRODUCTION TO DIGITAL SIGNAL PROCESSORS   **9**

DSP functionalities - circular buffering - DSP architecture - Fixed and Floating pointarchitecture principles - Programming - Application examples.

LIST OF EXPERIMENTS
MATLAB / EQUIVALENT SOFTWARE PACKAGE

1. Generation of elementary Discrete-Time sequences.
2. Linear and Circular convolutions.
3. Auto correlation and Cross Correlation.
4. Frequency Analysis using DFT.
5. Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrates the filtering operation.
6. Design of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF).
7. Verification of Sampling Theorem.

DSP PROCESSOR BASED IMPLEMENTATION

1. Study of architecture of Digital Signal Processor
2. Perform MAC operation using various addressing modes
3. Generation of various signals and random noise.
4. Design and demonstration of FIR Filter for Low pass, High pass, Band pass and Band stop filtering.
5. Design and demonstration of Butter worth and Chebyshev IIR Filters for Low pass, High pass, Band pass and Band stop filtering.

                                              TOTAL: 45+15=60 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Apply DFT for the analysis of digital signals and systems.
- Design and Realize IIR Filters.
- Design and Realize FIR filters using windows.
- Characterize the effects of finite precision representation on digital filters.
- Summarize architecture and instruction sets of TMS320C5X Processor.
- Demonstrate their abilities towards MATLAB based implementation of various DSP systems.

TEXT BOOKS

1. John G. Proakis & Dimitris G.Manolakis, "Digital Signal Processing - Principles, Algorithms & Applications", 4th Edition, Pearson Education / Prentice Hall, 2007.

2. Emmanuel C. Ifeachor & Barrie. W. Jervis, "Digital Signal Processing", 2nd Edition, Pearson Education / Prentice Hall, 2002.

REFERENCES

1. V. Oppenheim, R.W. Schafer and J.R. Buck, "Discrete-Time Signal Processing",8th Indian Reprint, Pearson, 2004.

2. Andreas Antoniou, "Digital Signal Processing", Tata Mc Graw Hill, 2006.

E-RESOURCES

1. https://nptel.ac.in/courses/117/102/117102060/ (Digital Signal Processing)

2. https://nptel.ac.in/courses/108/106/108106151/ (Digital Signal Processing)

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19ECE503	MICROPROCESSORS AND MICROCONTROLLERS	L T P C
	(Lab Embedded Theory Course)	3 0 2 4

OBJECTIVES

The student should be made to:

- Understand the Architecture of 8086 microprocessor.

- Learn the design aspects of Memory Interfacing circuits.

- Interface microprocessors with supporting chips.

- Study the Architecture of 8051 microcontroller.

- Design a microcontroller – based system.

- Write Program to interface different I/O's with 8086 Processor and 8051 Microcontroller.

UNIT I: THE 8086 MICROPROCESSOR   9

Introduction to 8086 - Microprocessor architecture - Addressing modes - Instruction set and assembler directives - Assembly language programming - Modular Programming - Linking and Relocation - Stacks - Procedures - Macros - Interrupts and interrupt service routines - Byte and String Manipulation.

UNIT II: 8086 SYSTEM BUS STRUCTURE   9

8086 signals - Basic configurations - System bus timing -System design using 8086 - I/O programming - Introduction to Multiprogramming - System Bus Structure - Multiprocessor configurations - Coprocessor, Closely coupled and loosely Coupled configurations - Introduction to advanced processors.

UNIT III: I/O INTERFACING   9

Memory Interfacing and I/O interfacing - Parallel communication interface - Serial communication interface - D/A and A/D Interface - Timer - Keyboard /display controller - Interrupt controller - DMA controller - Programming and applications Case studies: Traffic Light control, LED display , LCD display, Keyboard display interface and Alarm Controller.

UNIT IV: MICROCONTROLLER   9

Architecture of 8051 - Special Function Registers(SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Assembly language programming.

UNIT V: INTERFACING MICROCONTROLLER   9

Programming 8051 Timers - Serial Port Programming - Interrupts Programming - LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation - Comparison of Microprocessor, Microcontroller, PIC and ARM processors.

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LIST OF EXPERIMENTS

8086 Programs using kits and MASM

1. Basic arithmetic and Logical operations.
2. Move a data block without overlap.
3. Ascending Descending Order.

Peripherals and Interfacing Experiments

1. Stepper motor control.
2. Key board and Display.
3. A/D and D/A interface and Waveform Generation.
4. Traffic light Controller

8051 Experiments using kits and MASM

1. Basic arithmetic and Logical operations.
2. Square and Cube program, Find 2's complement of a number.

TOTAL: 45+15=60 PERIODS

OUTCOMES:

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

- Understand and execute programs based on 8086 microprocessor.
- Design Memory Interfacing circuits.
- Design and interface I/O circuits.
- Design and implement 8051 microcontroller based systems.
- Develop counters and Time delay circuits.
- Interface different I/O's with Processor and Controller.

TEXT BOOKS:

1. Yu-Cheng Liu, Glenn A.Gibson, "Microcomputer Systems: The 8086 / 8088 Family Architecture, Programming and Design", 2nd Edition, Prentice Hall of India, 2007.
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", 2nd Edition, Pearson education, 2011.

REFERENCES:

1. Doughlas V.Hall, "Microprocessors and Interfacing, Programming and Hardware",TMH,2012.
2. A.K.Ray,K.M.Bhurchandi, "Advanced Microprocessors and Peripherals" 3rd edition, Tata Mc Graw Hill, 2012.

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E-RESOURCES:

1. https://nptel.ac.in/courses/108/105/108105102/ (Microprocessors and Microcontrollers)

2. https://nptel.ac.in/courses/106/108/106108100/ (Microprocessors and Microcontrollers)

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19MDC501	VALUE ADDED COURSE – II	L T P C
		- - - -

OBJECTIVES

- Students are exposed to understand and translate medical information and patient diagnoses into medical code
- Students can learn to assisting the physicians by gathering information for patient visits, manage electronic health records (EHR), and fair acquaintance with medical terminology.
- Students can define the attributes of an Intensive Care Unit specialist as a practitioner, a member of a health care team, and as an individual.
- Students learn to design and print of more complex designs than traditional manufacturing processes
- Students are exposed to diagnose or treat patients by recording images of the internal structure of the body to assess the presence or absence of disease, foreign objects, and structural damage or anomaly.

ANY ONE OF THE COURSE IN THE LIST:

a. **MEDICAL CODING**

b. **MEDICAL SCRIBING**

c. **TRAINING ON ICU EQUIPMENTS**

d. **3D PRINTING**

e. **TRAINING AND CALIBRATION OF RADIOLOGICAL EQUIPMENTS**

OUTCOMES

At the end of this course, the students are able to :

- Translate medical information and patient diagnoses into medical code
- Assist the physicians by gathering information for patient visits, manage electronic health records (EHR), and fair acquaintance with medical terminology.
- Define the attributes of an Intensive Care Unit specialist as a practitioner, a member of a health care team, and as an individual.
- Design and print of more complex designs than traditional manufacturing processes.
- Diagnose or treat patients by recording images of the internal structure of the body to assess the presence or absence of disease, foreign objects, and structural damage or anomaly.

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19EEC501	**QUANTITATIVE APTITUDE LEARNING**	**L T P C**
	(Common to all Branches)	**0 2 0 0**

OBJECTIVES

- Introduce the basics concepts and techniques of numbers, Highest common factor and Least common multiple.
- Develop the use of decimal fraction and problems on ages.
- Introduce basic concepts of time, work, distance, calender and clock.
- Acquaint the student with the concept of simple and compound interest.
- Produced the knowledge of polynomial and quadratic equations.

UNIT I NUMBERS, HIGHEST COMMON FACTOR AND LEAST COMMON MULTIPLE 9

Numbers and their basic classification – Types of number – Basic operations of numbers – Progression – Tests of divisibility – Highest common factor – Least common multiple.

UNIT II DECIMAL FRACTION AND PROBLEMS BASED ON AGES 9

Decimal fraction – Types of fraction – Comparison of fractions – Inserting fractions in between two given fractions – Relation between decimal fraction and normal fraction – Conversion of a decimal fraction into a vulgar fraction – Types of decimals – Conversion of mixed recurring decimal into a vulgar fraction – Standard form of decimal – Problems based on ages.

UNIT III TIME, WORK, DISTANCE, CALENDER AND CLOCK 9

General rule for time and work – General rule for work and wages – Speed – Unit of speed – Average speed – Some useful relations – Problems on Trains – Calenders and clocks – Odd days – Ordinary year – Leap year.

UNIT IV SIMPLE INTEREST, COMPOUND INTEREST AND ELEMENTARY ALGEBRA 9

Simple interest – Compound interest – Some useful relations – Difference between compound interest and simple interest – Short cut methods to solve special types of problems – Elementary Algebra and averages.

UNIT V POLYNOMIAL AND QUADRATIC EQUATIONS 9

Polynomial introduction – Degree of a polynomial – Types of polynomial – Operations on polynomial – Remainder and factor theorem – Quadratic equation – Pure Quadratic equation – Discriminant – Roots of the Quadratic equations – Solution of Quadratic equation – Framing of a Quadratic equation – Special types of roots.

TOTAL: 45 PERIODS

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OUTCOMES

Upon completion of the course, the students will be able to:

- Use the basic concepts and techniques of the numbers, Highest common factor and Least common multiple.

- Apply the concept of decimal fraction and problems on ages.

- Apply the concept of time, work, distance, calender and clock.

- Acquire skills in simple interest, compound interest and elementary algebra.

- Be exposed to concepts and properties of polynomial and quadratic equations.

TEXT BOOKS

1. Aggarwal R.S., "Quantitative Aptitude", S.Chand & Company Ltd, New Delhi, 2012.

2. Dinesh Khattar, "Quantitative Aptitude for competitive examinations ", Pearson India Education Services Pvt. Ltd, New Delhi, 2019.

REFERENCES

1. Praveen R.V., "Quantitative Aptitude and Reasoning", PHI Learning Private Limited, Delhi, 2013.

2. Gupta P, "A unique Approach to Quantitative Aptitude ", Unique Publishers (I) Pvt. Ltd, New Delhi, 2017.

E-RESOURCES

1. https://youtube.com/playlist?list=RDQM5Xl256aOq24

2. https://youtu.be/KE7tQf9spPg

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SEMESTER VI

19MDT601 **BIOSTATISTICS AND RESEARCH METHODOLOGY** **L T P C**

3 1 0 4

OBJECTIVES

The student should be made to:

- Analyze statistical data which helps the engineers for practical applications.
- Identify the strength and direction of a linear relationship between two variables and also predict changes in dependent and independent variables.
- Gain the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- Know the operation of M.S. Excel, R and Design of Experiment .
- Understand the effects of two independent variables

UNIT I   BASICS OF STATISTICS AND PROBABILITY DISTRIBUTIONS   9+3

Statistics, Biostatistics, Frequency distribution - Measures of central tendency: Mean, Median, Mode - Measures of dispersion: Dispersion, Range, Standard deviation - Probability**:** Definition of probability, Binomial distribution, Poisson's distribution, Normal distribution.

UNIT II   CORRELATION AND REGRESSION   9+3

Correlation: Definition, Karl Pearson's coefficient of correlation – Rank correlation - Regression: Curve fitting by the method of least squares, fitting the lines $y = a + bx$

UNIT III   TESTING OF HYPOTHESIS AND DESIGN OF EXPERIMENTS   9+3

Population, large sample, small sample – Type – I Error, Type – II Error, Parametric test: Student's 't' - test - Tests for single mean, difference of means - Chi square test for goodness of fit – Independence of attributes - One way and two way classifications - Completely randomized design – Randomized block design

UNIT IV   INTRODUCTION TO RESEARCH AND STATISTICAL ANALYSIS   9+3

Need for research, Need for design of Experiments,Experiential Design Technique, plagiarism - Introduction to Practical components of Industrial and Clinical Trial Problems:Statistical Analysis Using Excel, design of experiments, R - Online Statistical Software's to Industrial and Clinical trial approach

UNIT V   DESIGN AND ANALYSIS OF EXPERIMENTS   9+3

Factorial Design**:** Definition, 2^2, 2^3 design - Advantage of factorial design.

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TOTAL : 45+15=60 PERIODS

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OUTCOMES

Upon completion of this course, the students will be able to:

- Statistics deals with data collected for specific purpose and make decisions about the data by analysing and interpreting.
- Able to identify the types of correlation, correlation between variables, and predict unknown values using regression.
- Apply the concept of testing of hypothesis for small and large samples in real life problems.
- Understand a variety of statistical software packages to enter and manage data, and to calculate and combine descriptive statistical parameters..
- Determine the design of experiments, and how to analyze them properly to answer various research questions.

TEXT BOOKS

1. S.C.Gupta., "Fundamental of Statistics", Himalaya Publishing House, 7th Edition, 2017.
2. C.R.Kothari, "Research Methodology", Cengage Learning, Second Revised Edition, New age International Publishers, New Delhi, 1990.

REFERENCES

1. R.Pannerselvam., "Design and Analysis of Experiments", PHI Learning Private Limited, 2012.
2. Douglas and C. Montgomery., "Design and Analysis of Experiments", Wiley Students 10th Edition, 2019.
3. Marcel Dekker., "Pharmaceutical statistics", Practical and clinical applications, Sanford Bolton Publisher, New York, 1990.

E-RESOURCES

1. https://kupdf.net/download/fundamental-of-stat-by-s-c-gupta_597f7044dc0d60656d2bb180_pdf
2. https://www.pdfdrive.com/research-methodology-methods-and-techniques-e170503040.html

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19MDT602	RADIOLOGICAL EQUIPMENTS	L T P C
		3 0 0 3

OBJECTIVES

The student should be made to:

- Understand generation of x-rays and its applications in imaging.
- Learn different types of radio diagnostic techniques.
- Know techniques used for visualizing different sections of the body
- Understand the concepts of Nuclear Imaging System.
- Learn radiation therapy methodologies and the radiation safety.

UNIT I: MEDICAL X-RAY EQUIPMENT   9

Nature of X-rays, X-Ray absorption – Tissue contrast. X- Ray Equipment (Block Diagram) – X-Ray Tube, collimator, Bucky Grid, power supply. Digital Radiography-discrete digital detectors, storage phosphor and film scanning. Fluoroscopy - X-ray Image Intensifier tubes — Digital Fluoroscopy. Angiography - cine Angiography, Digital subtraction Angiography. Mammography.

UNIT II: COMPUTED TOMOGRAPHY   9

Principles of tomography, CT Generations - X- Ray sources, collimation, X- Ray detectors, Viewing systems, spiral CT scanning, ultra fast CT scanners. Image reconstruction techniques- back projection and iterative method.

UNIT III: MAGNETICRESONANCE IMAGING   9

Fundamentals of magnetic resonance- Interaction of Nuclei with static magnetic field and Radiofrequency wave, rotation and precession. Induction of magnetic resonance signals — bulk Magnetization, Relaxation processes T1 and T2. Block Diagram approach of MRI system- system Magnet (Permanent, Electromagnet and Super conductors), Gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, Electronic components. fMRI.

UNIT IV: NUCLEAR IMAGING SYSTEM   9

Radio Isotopes- alpha, beta, and gamma radiations. Radiopharmaceuticals. Radiation detectors — gas filled, ionization chambers, proportional counter, GM counter and scintillation Detectors. Gamma camera- Principle of operation, collimator, photo multiplier tube, X-Y positioning circuit, pulse height Analyzer. Principles of SPECT and PET.

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UNIT V: RADIATION THERAPY AND RADIATION SAFETY   9

Effects of radiation- direct and indirect. Radiation therapy — linear accelerator, Tele gamma Machine. Recent Techniques in radiation therapy - Stereotaxic Radiosurgery, Stereotaxic Radiotherapy, 3D CRT, IMRT, IGRT and Cyber knife. Radiation measuring instruments- Dosimeter, film Badges, Thermo Luminescent dosimeters- electronic dosimeter. Radiation protection in medicine- radiation protection principles, ICRP,AERB.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of this course, the students will be able to:

- Explain about measurements of parameters related to respiratory system
- Appreciate the use of advanced laser technology in diagnosis and minimally invasive therapies.
- Analyze different types of diathermy units.
- Understand the concepts of ultrasound equipment.
- Identify the electrical hazards and Implement methods of patient safety.

TEXT BOOKS

1. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, "Biomedical Instrumentation and Measurements", Pearson Education India; 2nd Edition, 2015.
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology", Pearson Education, 4th Edition, 2014.

REFERENCES

1. John G.Webster, "Medical Instrumentation Application and Design", John Wiley and Sons,New York, 4th edition, 2009..
2. Antony Y.K.Chan, "Biomedical Device technology, Principles and design'', Charles ThomasPublisher Ltd, Illinois, USA, 2008

E-RESOURCES

1. https://onlinecourses.nptel.ac.in/noc21_bt50/preview
2. https://www.digimat.in/nptel/courses/video/113106069/L01.html

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19MDT603   ELECTRICAL SAFETY AND QUALITY ASSURANCE IN HOSPITAL   L T P C
                                                                     3 0 0 3

OBJECTIVES

The student should be made to:

- Understand the types of electrical hazards.
- Learn different standards and requirements of electrical safety.
- Know techniques used for electrical protection and maintenance
- Understand the concepts of standardization of quality medical care in hospitals.
- Learn the regulatory requirement for healthcare..
- Provide electrical protection and maintenance in working environment and ensure that electricalsafety..

UNIT I: ELECTRICAL HAZARDS   9

Review of Electrical concept, Electrostatic – Electro magnetism – Electrical Hazards – Energy leakage – Clearance and insulation– Current surges – Electrical causes of fire and explosion – Human interface with electricity – Human resistance to electricity

UNIT II STANDARDS AND REQUIREMENTS   9

National electrical Safety code - Standards and statutory requirements – Indian electricity acts and rules — statutory requirements from Electrical inspectorate. Hazardous area classification and classification of electrical equipments for hazardous areas (IS, NFPA, API and OSHA standards).

UNIT III: ELECTRICAL PROTECTION AND MAINTENANCE   9

Selection of Environment, Protection and Interlock – Discharge rods and earthing device – Safety in the use of portable tools - Preventive maintenance. First aid-cardio pulmonary resuscitation(CPR).

UNIT IV: STANDARDIZATION OF QUALITY MEDICAL CARE IN HOSPITALS   9

Define Quality- Need for Standarization & Quality Management, QM in Health care organization- Quality assurance methods, QA in (Medical Imaging & Nuclear medicine) Diagnostic services —Classification of equipments.

UNIT V: REGULATORY REQUIREMENT FOR HEALTH CARE   9

FDA regulations, Accreditation for hospitals - JCI, NABH and NABL, National Fire protection association standard, IRPQ-Other regulatory Codes.

TOTAL: 45 PERIODS

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OUTCOMES

Upon completion of this course, the students will be able to:

- Develop knowledge and insight into the procedures used in quality control and assurance activities

- Identify the different standards and requirements of electrical safety

- Know the safety measures to be followed in hospitals.

- Understand the regulatory requirement for healthcare.

- Know the importance of electrical protection and maintenance in working environment and ensure that electricalsafety

TEXT BOOKS

1. B.M.Sakharkar, Principles of Hospital administration and Planning, JAYPEE Brothers, Medical Publishers (P) Ltd. 24

2. K.Shridhara Bhat, Quality Management, Himalaya Publishing House Cesar A. Cacere & Albert Zana, The Practice of Clinical Engg. Academic press, New York, 1977.

REFERENCES

1. Karen Parsley, Karen Parsley Philomena Corriganǁ Quality improvement in Healthcare, 2nd edition,Nelson Thrones Pub, 2002

2. Webster J.G and Albert M.Cook, Clinical Engg, Principles & Practices, Prentice Hall Inc., Englewood Cliffs, New Jersy, 1979.

E-RESOURCES

1. https://youtu.be/Ir5Y1g55WBw

2. https://archive.nptel.ac.in/courses/127/106/127106136/

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19MDE601 **DIGITAL IMAGE PROCESSING FOR MEDICAL ENGINEERS** **L T P C**
(Lab Embedded Theory Course) **3 0 2 4**

OBJECTIVES

The student should be made to:

- Become familiar with digital image fundamentals
- Get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- Learn concepts of degradation function and restoration techniques.
- Study the image segmentation and representation techniques.
- Become familiar with image compression and recognition methods

UNIT I: DIGITAL IMAGE FUNDAMENTALS   **9**

Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.

UNIT II IMAGE ENHANCEMENT   **9**

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

UNIT III: IMAGE RESTORATION   **9**

Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order
Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering.

UNIT IV: IMAGE SEGMENTATION   **9**

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.

UNIT V: IMAGE COMPRESSION AND RECOGNITION   **9**

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching

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LIST OF EXPERIMENTS

1. Image sampling and quantization
2. Analysis of spatial and intensity resolution of images.
3. Intensity transformation of images.
4. DFT analysis of images
5. Transforms (Walsh, Hadamard, DCT, Haar)
6. Histogram Processing and Basic Thresholding functions
7. Image Enhancement-Spatial filtering
8. Image Enhancement- Filtering in frequency domain
9. Image segmentation – Edge detection, line detection and point detection.
10. Image restoration

TOTAL: 45+15=60 PERIODS

OUTCOMES

Upon completion of this course, the students will be able to:

- Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.
- Operate on images using the techniques of smoothing, sharpening and enhancement.
- Understand the restoration concepts and filtering techniques.
- Learn the basics of segmentation, features extraction, compression and recognition methods for color models.
- Discuss the concept of image segmentation by morphological watershed.

TEXT BOOKS

1. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Pearson, 3rd Edition, 2010.
2. Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson, 2002.

REFERENCES

1. Kenneth R. Castleman, "Digital Image Processing", Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, "Digital Image Processing using MATLAB", Pearson Education, Inc., 2011.

E-RESOURCES

1. https://nptel.ac.in/courses/117/105/117105079/ (Digital Image Processing)
2. https://nptel.ac.in/courses/117/105/117105135/ (Digital Image Processing)

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19ECE702	**EMBEDDED SYSTEMS**	**L T P C**
	(Lab Embedded Theory Course)	**3 0 2 4**

OBJECTIVES

The student should be made to:

* Introduce the relevance of Embedded Computing and an ARM Processors.

* Know the basic ARM processors, Computing Platform and its case studies.

* Analysis the Program design and Program Model.

* Introduce the basic concepts of hard real time multiprocessing.

* Initiate the analytical concepts for effective programming.

* Introduce the basic concepts of Communication protocol.

UNIT I: INTRODUCTION TO EMBEDDED COMPUTING AND ARM PROCESSORS   9

Complex systems and microprocessors - Embedded system design process - Formalism for system design - Design example: Model train controller- ARM Processor Fundamentals-Instruction Set and Programming using ARM Processor.

UNIT II: COMPUTING PLATFORM   9

CPU: Programming input and output - Supervisor mode, exception and traps - Coprocessor - Memory system mechanism - CPU performance - CPU power consumption-CPU buses - Memory devices - I/O devices - Component interfacing- System Level Performance Analysis-Parallelism. Design Example: Data Compressor.

UNIT III: PROGRAM DESIGN AND ANALYSIS   9

Program design - Model of programs - Assembly and Linking - Basic compilation techniques - Program Optimization- Analysis and optimization of execution time, power, energy, program size - Program validation and testing- Example: Software Modem.

UNIT IV: PROCESS AND OPERATING SYSTEMS   9

Multiple tasks and Multi processes - Processes - Context Switching - Operating Systems - Priority based Scheduling- RMS and EDF - Inter Process Communication mechanisms - Evaluating operating system performance - Power optimization strategies for processes.

UNIT V: HARDWARE ACCELERATORS & NETWORKS   9

Multiprocessors- CPUs and Accelerators - Performance Analysis- Distributed Embedded Architecture - Networks for Embedded Systems:- I2C, CAN Bus, Ethernet, Myrinet - Network based design - Internet enabled systems. Design Example: Elevator Controller.

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LIST OF EXPERIMENTS

1. Study of ARM evaluation system.
2. Interfacing ADC and DAC.
3. Interfacing LED and PWM.
4. Interfacing real time clock and serial port.
5. Interfacing keyboard and LCD.
6. Interfacing EPROM and interrupt.
7. Mailbox.
8. Interrupt performance characteristics of ARM and FPGA.
9. Flashing of LEDS.
10. Interfacing stepper motor and temperature sensor.
11. Implementing zigbee protocol with ARM.
12. Interface 7SEG(7 Segment Display)

TOTAL: 45+15=60 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Design and develop ARM processor based system
- Comprehend and appreciate the significance and role of microcontrollers in embedded systems.
- Analyze and demonstrate program design and optimization and proper scheduling of the process.
- Apply the concept of process, multiprocesses and operating systems in embedded system design.
- Implement various communication protocols in distributed embedded computing platform.
- Design and develop ARM Processor based Programming.

TEXT BOOKS

1. Wayne Wolf, "Computers as Components - Principles of Embedded Computing System Design", Morgan Kaufmann Publisher (An imprint of Elsevier), 3rd edition, 2008.
2. Andrew N Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide- Designing and Optimizing System Software", Elsevier/Morgan Kaufmann Publisher, 2008.

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REFERENCES

1. David E-Simon, "An Embedded Software Prime", Pearson Education, 2010.

2. K.V.K.K.Prasad, "Embedded Real-Time Systems: Concepts, Design & Programming", Dreamtech press, 2005.

E-RESOURCES

1. https://nptel.ac.in/courses/108/102/108102045/ (Embedded Systems)

2. https://nptel.ac.in/courses/106/105/106105193/ (Embedded System Design with ARM)

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19MDJ601   **MINI PROJECT**   **L T P C**

0 0 2 1

OBJECTIVES

The student should be made to:

- Design and fabrication of one or more components of a complete working model, which is designed by them.
- Ability to fabricate any components using different manufacturing tools.

GUIDELINES FOR REVIEW AND EVALUATION

The students may be grouped into 2 to 4 and work under a project supervisor. The device/ system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 30 PERIODS

OUTCOMES

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

- Design and fabricate the products for medical applications.
- Demonstrate the working model for healthcare application.
- Patent registration and publication for the eligible design models.

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19MDC601	**CONSTITUTION OF INDIA**	**LT P C**
	(Common to all departments)	**3 0 0 0**

OBJECTIVES

The student should be made to:

- Understand the meaning of the Constitution law and Constitutionalism.
- Realize the fundamental rights.
- Understand the execution powers of union and states bout.
- Be aware of the Constitutional powers.
- Acquaint with other Constitutional functionaries.

UNIT I: INTRODUCTION   **3**

Meaning of the Constitution law and constitutionalism - Historical perspective of the Constitution of India - Preamble - Salient features and characteristics of the Constitution of India - Citizenship.

UNIT II: FUNDAMENTAL RIGHTS   **3**

Scheme of the fundamental rights - The scheme of the fundamental duties and its legal status - The directive principles of state policy - Its importance and implementation.

UNIT III: UNION AND STATE EXECUTIVE   **3**

Federal structure and distribution of legislative and financial powers between the Union and the States - Parliamentary form of Government in India - The Constitution powers and status of the President of India - Governor - Appointment, powers and functions.

UNIT IV: CONSTITUTIONAL POWERS   **3**

Amendment of the Constitutional powers and procedure - The historical perspectives of the Constitutional amendments in India - Emergency provisions: National emergency, President rule, financial emergency.

UNIT V: OTHER CONSTITUIONAL FUNCTIONARIES   **3**

Election Commission of India: Organization, powers and functions, Union Public Service Commission, State Public Service Commission - Local Self Government.

TOTAL: 15 PERIODS

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OUTCOMES

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

- Understand the salient features and characteristics of the Constitution of India.
- Analyze the scheme of the fundamental rights and duties.
- Evaluate in detail the powers between the Union and the States.
- Know the concept of Constitutional powers.
- Recognize other Constitutional functionaries.

TEXT BOOKS

1. Introduction to the Constitution of India - Durga Das Basu.
2. Our Constitution by Subhash by C. Kashyap.

REFERENCES

1. Indian Polity by Spectrum.
2. The Indian Constitution: Cornerstone of a Nation, by Granville Austin.

E-RESOURCES

1. https://www.youtube.com/watch?v=vq2Q1_v6TNU
2. https://www.india.gov.in/my-government/constitution-india/constitution-india-full-text

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SEMESTER VII

19MDT701   HOSPITAL ADMINISTRATION AND WASTE MANAGEMENT   L T P C
3 0 0 3

OBJECTIVES

The student should be made to:

- Understand the fundamentals of hospital administration

- Know the market related research process.

- Explore various information management systems and relative supportive services.

- Learn the quality and safety aspects in hospital.

- Understand the hazardous materials used in hospital and its impact on health

- Understand various waste disposal procedures and management

UNIT I: OVERVIEW OF HOSPITAL ADMINISTRATION AND WASTE MANAGEMENT   9

Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning- Equipment Planning – Functional Planning - Current Issues in Hospital Management –Telemedicine - Bio-Medical Waste Management..

UNIT II: HUMAN RESOURCE MANAGEMENT AND MARKETING RESEARCH PROCESS 9

Principles of HRM — Functions of HRM — Profile of HRD Manager — Tools of HRD – Human Resource Inventory – Manpower Planning. Different Departments of Hospital, Recruitment, Selection, Marketing information systems - assessing information needs, developing & disseminating information - Market Research process - Other market research considerations

UNIT III: QUALITY AND SAFETY ASPECTS IN HOSPITAL   9

Quality system – Elements, implementation of quality system, Documentation, Quality auditing, Loss Prevention – Fire Safety – Alarm System – Safety Rules. Health Insurance & Managing Health Care – Medical Audit – Hazard and Safety in a hospital Setup - Functioning of modern hospitals & changing need of patients - Hospitality in Hospital Care, Invasive and non-invasive diagnostic facilities in modern hospital - Care offered in Specialty and Super specialty Hospitals.

UNIT IV: BIOMEDICAL WASTE MANAGEMENT AND HAZARDOUS MATERIALS   9

Biomedical Waste Management : Types of wastes, major and minor sources of biomedical waste, Categories and classification of biomedical waste, hazard of biomedical waste, need for disposal of biomedical waste Healthcare Hazardous Materials, Medical Gas Systems, Hazardous Waste Operations and Emergency Response Standard, Respiratory Protection.

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UNIT V: INFECTION CONTROL, PREVENTION AND PATIENT SAFETY   9

Healthcare Immunizations, Centers for Disease Control and Prevention, Disinfectants, Sterilants, and Antiseptics, OSHA Bloodborne Pathogens Standard, Tuberculosis, Healthcare Opportunistic Infections, Medical Waste. Patient Safety: An Organizational Function, Errors and Adverse Events,Safety Cultures, Patient-Centered Healthcare.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Explain the principles of Hospital administration and Identify the importance of Human resource management
- List various marketing research techniques and Identify Information management systems
- Understand safety procedures followed in hospitals
- Analyse various hazards, accidents and its control and Design waste disposal procedures for different biowastes.
- Categorise different biowastes based on its properties and Design different safety facility in hospitals
- Propose various regulations and safety norms.

TEXT BOOKS

1. R.C.Goyal, ―Hospital Administration and Human Resource Management‖, PHI – Fourt Edition,2006.
2. Tweedy, James T., Healthcare hazard control and safety management-CRC Press_Taylor andFrancis (2014).

REFERENCES

1. Anantpreet Singh, Sukhjit Kaur, Biomedical Waste Disposal, Jaypee Brothers Medical Publishers (P) Ltd (2012).
2. G.D.Kunders, ―Hospitals – Facilities Planning and Management – TMH, New Delhi – FifthReprint 2007.

E-RESOURCES

1. https://dth.ac.in/medical/courses/Microbiology/block-9/3/index.php   (Biomedical Waste Management)
2. https://archive.nptel.ac.in/courses/110/107/110107080/ (Marketing Research)

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19MDE701	MEDICAL ELECTRONIC DEVICES AND DESIGN	L T P C
	(Lab Embedded Theory Course)	3 0 2 4

OBJECTIVES

The student should be made to:

- Explore the concepts in designing power systems for medical electronics.

- Understand the essential circuitry needed for sensor design.

- Develop an understanding of data acquisition system design.

- Provide knowledge about noise cancellation system

- Gain necessary knowledge about the hardware implementation of DSP.

UNIT I: DESIGN OF POWER SUBSYSTEMS IN MEDICAL ELECTRONICS   9

Transient voltage protections- Electromagnetic interference- Inrush current control Overvoltage protection- Under voltage protection- Overload protection- Output filtering- Power failure warning- Flightback switch back power supplies- Half-bridge Flyback converter

UNIT II: SENSOR DESIGN FUNDAMENTALS   9

Sensor parameters- Sensor Interfacing- Signal conditioning amplifiers- Instrumentation amplifiers- Isolation amplifiers- Charge-coupled device sensors- Position and motion sensors Accelerometers- Temperature sensors- Fiber optics based medical sensors

UNIT III: DATA ACQUISITION SYSTEMS   9

Sample and hold conversion- Multichannel acquisition- High speed sampling in ADC- Selection of drive amplifier for ADC performance- Driving ADCs with switched capacitor inputs- ADC input protection- External protection of amplifiers- High speed ADC architectures

UNIT IV: NOISE AND INTERFERENCE ISSUES IN ANALOG CIRCUITS   9

Noise calculations in Op-Amp- Internal noise in Op-Amps- Proper power supply decoupling Bypass capacitors and resonances- Designing power bus rails in power-ground planes for noise control- ASIC .

UNIT V: HARDWARE APPROACH TO DIGITAL SIGNAL PROCESSING   9

DSP hardware- Arithmetic logic unit- Multiplier-accumulator- Shifter- Data address generators Program sequencer- Serial ports- Interfacing ADCs and DACs to digital signal processors Parallel ADCs o DSP interface- Parallel DAC to DSP interface- Serial interfacing to DSP processors.

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LIST OF EXPERIMENTS

1. Study of PCB design software (open source) like KiCad, Eagle, etc.,
2. Design of a Bio Amplifier
3. Design of Bio-Electrode Equivalent Circuit
4. Design and setup a notch filter circuit and Active Band Pass Filter
5. Design and setup a threshold detector, sample and hold circuit using op-amp
6. Design and setup a Patient Isolation Circuit
7. Design of body temperature measuring circuit using thermistors
8. Design and setup a circuit for skin contact impedance
9. Design of Plethysmography circuit
10. Design of Pace Maker circuit
11. Design of Bio-Telemetry using IC4046
12. Design a Power Supply for Low Power Wearable Devices

TOTAL: 45+15=60 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Understand the power systems used in the design of medical electronics devices
- Classify the biosensors design according the type of device
- Interpret the data acquired from the sensors.
- Enumerate the noise and interference issues in the devices
- Understand the signal processing of the medical electronic device.

TEXT BOOKS

1. Peter J.Ogrodnik, "Medical Device Design: Innovation from Concept to Market" 2nd Edition, Kindle Edition Academic Press; 2nd edition (30 October 2019).
2. Reinaldo Perez "Design of Medical Electronic Devices Hardcover – 21" March 2002 Academic Press; 1st edition (21 March 2002).

REFERENCES

1. Kunal Pal, Heinz-Bernhard Kraatz, Anwesha Khasnobish, Bioelectronic and medical devices, Elsevier, 2019
2. Rüdiger Kramme, Klaus-Peter Hoffmann, Robert Steven Pozos, Springer handbook of medical technology, Springer, 2011.

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E-RESOURCES

1. https://www.youtube.com/watch?v=aBeRFdAA2og (Sensor Design Fundamentals)

2. https://www.youtube.com/watch?v=WwQSfk6SSSo **(**Data Acquisition Systems)

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19MDJ701   **HOSPITAL/INDUSTRY TRAINING**   **L T P C**
                                                                                 0 0 2 2

OBJECTIVES

The student should be made to:

- Observe medical professionals at work in the wards and the roles of Allied Health Professionals.
- Provide access to healthcare Professionals to get a better understanding of their work.
- Demonstrate patient-care in a hospital setting.
- Provide knowledge about noise cancellation system
- Gain necessary knowledge about the hardware implementation of DSP.

ASSESSMENT

Students need to complete training in any leading Multi-speciality hospital for a period of 15 days. They need to prepare an extensive report and submit to their respective course in-charges during the session

Out of the following departments, it is mandatory to complete training in any 10. The students can give a presentation of the remaining departments during laboratory hours

Sl.No.	Departments for visit
1.	Cardiology
2.	ENT
3.	Ophthalmology
4.	Orthopaedic and Physiotherapy
5.	ICU/CCU
6.	Operation Theatre
7.	Neurology
8.	Nephrology
9.	Radiology
10.	Nuclear Medicine
11.	Pulmonology
12.	Urology
13.	Obstetrics and Gynaecology
14.	Emergency Medicine

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15.	Biomedical Engineering Department
16.	Histo Pathology
17.	Biochemistry
18.	Paediatric/Neonatal
19.	Dental
20.	Oncology
21.	PAC's
22.	Medical Records / Telemetry
23	Medical device Manufacturing Industries
24	Medical Refab and Services Industry
25	Medical Waste Management or "R" Policy Industries.

. **TOTAL: 30 PERIODS**

OUTCOMES

Upon completion of the course, the students will be able to:

- Advocate a patient-centred approach in healthcare
- Communicate with other health professionals in a respectful and responsible manner
- Recognize the importance of inter-professional collaboration in healthcare.
- Propose a patient-centred inter-professional health improvement plan based upon the patient's perceived needs
- Use the knowledge of one's own role and those of other professions to address the healthcare needs of populations and patients served.

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SEMESTER VIII

19MDJ801	PROJECT WORK	L T P C
		0 0 20 12

OBJECTIVES

The student should be made to:

- Develop skills to formulate a technical project with problem identification.
- Develop the ability to resolve the identified problem.
- Design the products with "R" policy with the use of new tools, algorithms and techniques required to carry out the projects.
- Give guidance on the various procedures for validation of the product and analyze the cost effectiveness
- Provide guidelines to prepare technical report of the project and patent the eligible design.

GUIDELINE FOR REVIEW AND EVALUATION

The students in a group of 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

OUTCOMES

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

- Formulate a real world problem, identify the requirement and develop the design solutions.
- Identify technical ideas, strategies and methodologies.
- Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
- Prepare technical report and oral presentations.
- On completion of the project work students will be in a position to take up any challenging practical problem in the field of engineering and find better solutions to it.
- Patent registration and publication for the eligible design.

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PROFESSIONAL ELECTIVE-I

19MDPX01	BIOMEMS	L T P C
		3 0 0 3

OBJECTIVES

The student should be made to:

- To provide a broad view of the Micro system design and fabrication
- To give an idea about Thermo mechanics
- To develop thermal Effects on mechanical strength of materials
- To experience fluid mechanics– heat transfer
- Understand Design of micro fluidic network systems

UNIT I: OVERVIEW OF MEMS AND MICROSYSTEMS   9

Introduction- MEMS and Microsystems– Microsystem products– Principles of Micro systems- Microsensors - acoustic wave sensors, chemical sensors– optical sensors– Pressure sensors– thermal sensors– Microactuation– MEMS with Microactuators– Microaccelerometers– Microfludics. Micro system design and fabrication- Ion and Ionization– Electrochemistry

UNIT II: MICROSYSTEMS AND THERMO FLUID ENGINEERING   9

Introduction – Static bending of Thin plates– Mechanical vibration– resonant vibration– Thermo mechanics– Thermal Effects on mechanical strength of materials– creep deformation– Thermal stresses. Fracture Mechanics– Thin Film mechanics– equations in continuum fluid dynamics– computational fluid dynamics– Incompressible fluid flow in microconduits.

UNIT III: MATERIALS FOR MINIATURIZATION   9

Substrates and wafers– active substrate materials– Silicon substrate material– Silicon compounds– silicon piezoresistors– gallium arsenide– quartz– piezoelectric crystals- Polymers for MEMS and Microsystems– conductive polymers– Langmuir – Boldgent film– Laws for miniaturization– Scaling- geometry– rigid body dynamics– electrostatic forces– electromagnetic forces– electricity– fluid mechanics– heat transfer.

UNIT IV: MICROSYSTEM FABRICATION AND MICRO MANUFACTURING   9

Photolithography– ion implantation– diffusion– oxidation. Vapor deposition – physical and chemical– sputtering– etching- chemical etching and plasma etching. Bulk micro manufacturing surface micro machining– LIGA process– SLIGA process.

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UNIT V: MICROSYSTEM PACKAGING   **9**

Design of micro fluidic network systems– design constraints and selection of materials. Packaging of microelectronics– microsystem packaging– interfaces– three dimensional packaging– assembly of micro systems. Pressure sensor packaging.

                                                     TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Explain the basics of mems and microsystems
- Describe the functions, properties of micro sensors and thermo fluid engineering.
- Discuss the different types of materials used in the miniaturization process.
- Illustrate the manufacturing and fabrication of micro systems.
- Explain the process of packaging and its types.

TEXT BOOKS

1. Tai- Ran Hsu "MEMS & Microsystems design and manufacture"– Tata McGraw- Hill, New Delhi, 2007.

2. Steven s Saliterman, "Fundamentals of Biomems and Medical Microdevices", Spie press , USA, 1 st edition, 2006.

REFERENCES

1. Wanjun Wang and Steven A.Soper "Bio- MEMS technologies and applications", CRC Press, 1 st Edition,2007.

2. P.Rai- Choudhury " MEMS and MOEMS Technology and Applications", PHI Learning , New delhi, 2000.

E-RESOURCES :

1. NPTEL Video https://nptel.ac.in/courses/112/104/112104181/ "BioMEMS and Microsystems", Dr.Shantanu Bhattacharya, Department of Mechanical Engineering, IIT Kharagpur

2. NPTEL Video https://nptel.ac.in/courses/117/105/117105082/ "MEMS and Micro systems" Prof.Santiram Kal , Dept of EEE, IIT Kharagpur.

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19MDPX02	INTELLECTUAL PROPERTY RIGHTS	L T P C
		3 0 0 3

OBJECTIVES

The student should be made to:

- Give an idea about IPR, registration and its enforcement.

- Know about registration process of IPR

- Understand the procedures of agreements and Legislations.

- Know about digital products and laws.

- Learn about enforcements of IPRs

UNIT I: INTRODUCTION   9

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT II: REGISTRATION OF IPRs   9

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad.

UNIT III: AGREEMENTS AND LEGISLATIONS   9

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

UNIT IV: DIGITAL PRODUCTS AND LAW   9

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

UNIT V: ENFORCEMENT OF IPRs   9

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

TOTAL: 45 PERIODS

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OUTCOMES

Upon completion of the course, the students will be able to:

- Manage Intellectual Property portfolio to enhance the value of the firm.
- Describe the registration process of IPR.
- Review the procedures of agreements and Legislations.
- Discuss about the laws that governs digital products.
- Explain the about enforcements of IPRs.

TEXT BOOKS

1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012.
2. S. V. Satakar, "Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002.

REFERENCES

1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012.

2. Prabuddha Ganguli,"Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2011.

E-RESOURCES :

1. https://www.digimat.in/nptel/courses/video/117105138/L01.html
2. https://www.youtube.com/watch?v=7k5rCsnlMSI

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19MDPX03	**NANOTECHNOLOGY AND APPLICATIONS**	**L T P C**
		3 0 0 3

OBJECTIVES

The student should be made to:

- Understand the basics of nanoscience and nanotechnology
- Explore the basics of nonmaterial synthesis and characterization.
- Know the applications of nanotechnology
- Develop Lithography techniques
- Learn Nano structures and their applications

UNIT I: INTRODUCTION TO NANOTECHNOLOGY   9

Basic Structure of Nanoparticles- Kinetics in Nanostructured Materials- Zero dimensional, size and shape of nanoparticles; one-dimensional and two dimensional nanostructures- clusters of metals and semiconductors, bionano-particles.

UNIT II: FABRICATION AND CHARACTERIZATION OF NANOMATERIALS   9

Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Buckyballs, Nanotubes); Gas, liquid, and solid –phase synthesis of nanomaterials; Lithography techniques (Photolithography, Dip-pen and Electron beam lithography); Thin film deposition; Electrospinning. Bio-synthesis of nanomaterials.

UNIT III: PROPERTIES AND MEASUREMENT OF NANOMATERIALS   9

Optical Properties: Absorption, Fluorescence, and Resonance; Methods for the measurement of nanomaterials; Microscopy measurements: SEM, TEM, AFM and STM. Confocal and TIRF imaging.

UNIT IV: NANO STRUCTURES   9

Carbon Nanotubes, Fullerenes, Nanowires, Quantum Dots. Applications of nanostructures. Reinforcement in Ceramics, Drug delivery, Giant magnetoresistance, etc. Cells response to Nanostructures.

UNIT V: APPLICATIONS OF NANOTECHNOLOGY   9

Nano electronics, Nanosensors, Nanotechnology in Diagnostics applications, Environmental and Agricultural Applications of nanotechnology, Nano technology for energy systems.

TOTAL: 45 PERIODS

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OUTCOMES

Upon completion of the course, the students will be able to:

- Describe the basic science behind the properties of materials.

- Interpret the creation, characterization, and manipulation of nanoscale materials.

- Comprehend the exciting applications of nanotechnology at the leading edge of scientific research

- Apply their knowledge of nanotechnology to identify how they can be exploited for new applications.

- Explain the Applications of nanostructures

TEXT BOOKS

1. Springer Handbook of Nanotechnology by Bharat Bhushan 2004.
2. Encyclopedia of Nanotechnology - Hari Singh Nalwa 2004.

REFERENCES

1. Nanomaterials, Nanotechnologies and Design: an Introduction to Engineers and Architects, D. Michael Ashby, Paulo Ferreira, Daniel L. Schodek, Butterworth-Heinemann,2009.

2. Handbook of Nanophase and Nanostructured Materials (in four volumes), Eds: Z.L. Wang, Y. Liu, Z. Zhang, Kluwer Academic/Plenum Publishers, 2003.

E-RESOURCES :

1. https://www.youtube.com/watch?v=qUEbxTkPIWI
2. https://www.digimat.in/nptel/courses/video/113102080/L29.html

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19MDPX04	COMPUTERS IN MEDICINE	L T P C
		3 0 0 3

OBJECTIVES

The student should be made to:

- To study the 8086 architecture, instruction sets and various units of PC-AT.

- Study the technique of data acquisition, storage, retrieval and transmission of bio information.

- To understand the application of computers in patient monitoring.

- To understand the application of computers in system modelling and pattern recognition, medical imaging and development of expert systems.

- Study the pattern recognition techniques in medical image classification

UNIT I: OVERVIEW OF COMPUTER HARDWARE PC-AT   9

8086 architecture, system connections, Instruction set & programming, Microcontrollers, Motherboard and its logic, RS232-C and IEEE bus standards, CRT controllers, FDC, HDC and Post sequence, PC based video card, modems and networking.

UNIT II: SYSTEM DESIGN   9

Multichannel computerised ECG, EMG and EEG data acquisition, storage and retrieval, transmission of signal and images.

UNIT III: COMPUTERS IN PATIENT MONITORING   9

Physiological monitoring, automated ICU, computerised arrhythmia monitoring, information flow in a clinical lab, computerised concepts, interfacing to HIS.

UNIT IV: COMPUTERS IN MEDICAL SYSTEMS MODELLING   9

Radiotherapy, drug design, drug delivery system, physiological system modelling and simulation.

UNIT V: COMPUTERS IN MEDICAL RESEARCH   9

Role of expert systems, pattern recognition techniques in medical image classification, ANN concepts.

TOTAL: 45 PERIODS

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OUTCOMES

Upon completion of the course, the students will be able to:

- Describe the overview of computer hardware PC-AT
- Discuss system design for ECG,EMG and EEG data acquisition
- Handle effectively patient monitoring systems
- Analyze computers in medical systems modeling.
- Effectively utilize the computers in medical research.

TEXT BOOKS

1. R.D.Lee, "Computers in Medicine", Tata McGraw-Hill, New Delhi, 1999.
2. Douglas V.Hall, "Microprocessors and Interfacing : Programming and hardware", McGraw-Hill, Singapore, 1999.

REFERENCES

1. Computers in Medicine Hardcover – 1 January 2006 by Lele (Author).
2. Computers in Medicine - Progress in Medical Informatics (English, Hardcover, Lele R D).

E-RESOURCES :

1. https://www.youtube.com/watch?v=YTH-CXphdXw
2. https://www.digimat.in/nptel/courses/video/112107214/L01.html

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19MDPX05	INTRODUCTION TO BIO ENERGY AND BIO FUELS	L T P C
		3 0 0 3

OBJECTIVES

The student should be made to:

- Study the basics of Bioenergy and Biofuels..
- Discuss the different generation biofuels and feedstocks..
- Understand the conversion technologies in biofuels..
- Know the engineering applications of Biofuels..
- Improve Bioenergy sustainability

UNIT I: CONCEPTS   9

Biopower, Bioheat, Biofuesl, advanced liquid fuels, drop-in fuels, biobased products.

UNIT II: FEEDSTOCKS   9

Harvested Feedstocks: First generation biofuels, Second generation biofuels, third generation biofuels. Residue Feedstocks: Agricultural wastes, forestry wastes, farm waste, organic components of residential, commercial, institutional and insdustrial waste.

UNIT III: CONVERSION TECHNOLOGIES   9

Biorefinery concept – biorefineries and end products, Biochemical conversion – hydrolysis, enzyme and acid hydrolysis, fermentation, anaerobic digestion and trans-esterification, Thermochemical conversion – Combustion, Gasification, Pyrolysis, other thermochemical conversion technologies. Scaling up of emerging technologies.

UNIT IV: BIOFUELS   9

Pros and cons of Biofuels, Algal biofuels, Cyanobacteria and producers of biofuels, Jatropha as biodiesel producer, Bioethanol, Biomethane, biohydrogen, biobutanol, metabolic engineering of fuel molecules, Engineering aspects of biofuels, Economics of biofuels.

UNIT V: SUSTAINABILITY & RESILIENCE   9

Environmental Sustainability, bioenergy sustainability, emissions of biomass to power generation applications, emissions from biofuels. ILUC issues, Carbon footprint, Advanced low carbon fuels.

TOTAL: 45 PERIODS

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OUTCOMES

Upon completion of the course, the students will be able to:

- Explain the basics of Bioenergy and Biofuels..
- Categorize the different generation biofuels and feedstocks..
- Familiarize with the conversion technologies in biofuels..
- Analyze the engineering applications of Biofuels..
- Highlight the importance of Bioenergy sustainability

TEXT BOOKS

1. Biorenewable Resources – Engieering new products. Robert C Brown. Blackwell Publishing Professional, 2003.
2. Biofuels - Wim Soetaert and Erik Vandamme (Editors) Wiley. 2009.

REFERENCES

1. Introduction to Bioenergy. Vaughn C. Nelson and Kenneth L. Starcher.
2. Bioenergy: Biomass to Biofuels by Anju Dahiya.

E-RESOURCES :

1. https://dituniversity.digimat.in/nptel/courses/video/105105184/L17.html
2. https://www.digimat.in/nptel/courses/video/103103207/L14.html

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PROFESSIONAL ELECTIVE-II

19MDPX06	MEDICAL ETHICS AND STANDARDS	L T P C
		3 0 0 3

OBJECTIVES

The student should be made to:

- Achieve familiarity with some basic ethical framework & understand how these ethical frameworks can help us to think through contemporary questions in medical ethics
- Know about the legal and ethical principles and application of these principles in health care settings & gain knowledge about the medical standards that to be followed in hospitals.
- Understand the Hospital Accreditation Standards.
- Know the various Hospital Safety Standards.
- Familiarize with the various medical equipment safety standards..

UNIT I: INTRODUCTION TO MEDICAL ETHICS   9

Definition of Medical ethics, Scope of ethics in medicine, American medical Association code of ethics, CMA code of ethics- Fundamental Responsibilities ,The Doctor And The Patient, The Doctor And The Profession, Professional Independence, The Doctor And Society.

UNIT II: ETHICAL THEORIES & MORAL PRINCIPLES   9

Theories-Deontology & Utilitarianism ,Casuist theory, Virtue theory, The Right Theory. PrinciplesNon- Maleficence, Beneficence, Autonomy, Veracity, Justice. Autonomy & Confidentiality issues in medical practice, Ethical Issues in biomedical research ,Bioethical issues in Human Genetics & Reproductive Medicine.

UNIT III: HOSPITAL ACCREDITATION STANDRADS   9

Accreditation - JCI Accreditation & its Policies. Patient centered standards, Healthcare Organization management standards -Indian Perspective.

UNIT IV: HOSPITAL SAFETY STANDARDS   9

Life Safety Standards- Protecting Occupants, Protecting the Hospital From Fire, Smoke, and Heat, Protecting Individuals From Fire and Smoke, Providing and Maintaining Fire Alarm Systems, Systems for Extinguishing Fires Environment of Care Standards-Minimizing EC Risks, Smoking Prohibitions, Managing Hazardous Material and Waste, Maintaining Fire Safety Equipment, Features, Testing, Maintaining, and Inspecting Medical Equipment.

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UNIT V: MEDICAL EQUIPMENT SAFETY STANDARDS **9**

General requirements for basic safety & essential performance of medical equipments.IEC 60601 standards- Base Standard-general requirement of electrical medical devices, Collateral StandardsEMC radiation protection &programmable medical device system, Particular Standards-type of medical device.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Describe the importance of medical ethics.
- Understand the moral principles of medical ethics.
- Review the Hospital Accreditation Standards
- Understand various Hospital Safety Standards
- Gain knowledge on various medical equipment safety standards.

TEXT BOOKS

1. Methods in Medical Ethics: Second Edition Paperback – Import, 15 October 2010 by Daniel P. Sulmasy (Editor), Jeremy Sugarman (Editor).

2. Medical Ethics: A Very Short Introduction (Very Short Introductions) Paperback – Illustrated, 22 November 2018 by Michael Dunn (Author), Tony Hope (Author).

REFERENCES

1. Biomedical Ethics: A Canadian Focus. Johnna Fisher (ed.), Oxford University Press Canada 2009.

2. Bioethics - An Introduction for the biosciencesǁ, 2 nd edition 2008, Ben Mepham, Oxford.

E-RESOURCES :

1. https://onlinecourses.nptel.ac.in/noc20_mg65/preview
2. https://amrita.digimat.in/nptel/courses/video/105102176/L08.html

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19MDPX07   **NEURAL NETWORKS AND ITS APPLICATIONS**   **L T P C**
3 0 0 3

OBJECTIVES

The student should be made to:

- Understand the basic neural network architectures and learning algorithms.
- Know the applicationsin pattern recognition, image processing, and computer vision..
- Explore the use of Pattern and Neural Classifiers for classification applications.
- Introduce neural computing as an alternative knowledge acquisition/representation paradigm.
- Know the applications of Neural Networks.

UNIT I: FROM BIOLOGY TO ARTIFICIAL NEURAL NETWORKS –INTRODUCTION   9

Brief History of Neural Networks, Biological Neural Networks, Components of Artificial Neural Networks – Connections, Propagation function and Network Inputs, Common Activation Functions, Threshold, Network Topologies, Bias Neuron, Fundamentals of Learning and Training ― Supervised, Unsupervised, Reinforcement, Training Pattern and Teaching Input, Learning Curve and Error measurement.

UNIT II: SUPERVISED NETWORK LEARNING PARADIGMS   9

Perceptron and backpropagation ― Single Layer Perceptron, Convergence theorem, delta rule, Linear Separability, Multilayer Perceptron, Backpropagation of error, variation and extension to backpropagation. Recurrent perceptron like networks.

UNIT III: ASSOCIATIVE NETWORK AND NETWORK BASED ON COMPETITION   9

Associative Memory ― Different types of Pattern Association, Bidirectional Associative Memory, and Hopfield Memory. Self Organizing feature maps, Linear Vector Quantization, Counter Propagation Networks.

UNIT IV: OTHER ADVANCE NEURAL NETWORKS   9

Radial Basis Functions, Support Vector Machines, Extreme Learning Machine, Extended Extreme Learning Machine, Principle component Analysis, Deep Learning and Hierarchical Temporal Memory.

UNIT V: APPLICATION OF NEURAL NETWORKS   9

ANN in Computer-Aided Diagnosis, ANN as multivariate statistical model, ANN for medical Image segmentation, ANN as a predictive model, ANN as a optimizer.

TOTAL: 45 PERIODS

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OUTCOMES

Upon completion of the course, the students will be able to:

- Describe the neural network architecture and learning algorithms
- Implement Pattern and Neural Classifiers for various classification applications
- Review the neural computing as an alternative knowledge acquisition/representation paradigm
- Understand various advanced Neural Networks.
- Explore the applications of Neural Networks.

TEXT BOOKS

1. David Kriesel, ―A Brief Introduction to neural networks.
2. Laurene Fausett, ―Fundamentals of neural networks- Architectures, algorithms and applications‖, Prentice Hall, 1994.

REFERENCES

1. James A Freeman and David M.Skapra, Neural Networks: Algorithms, Applications, and Programming Techniques, Addison-Wesley, 1991, Digital Version 2007.
2. Simon O. Haykins, Neural Networks: A Comprehensive Foundation, 2nd Edition, Pearson 1994.

E-RESOURCES :

1. https://www.digimat.in/nptel/courses/video/106105183/L01.html
2. https://www.digimat.in/nptel/courses/video/117105075/L21.html

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19MDPX08	BODY AREA NETWORKS	L T P C
		3 0 0 3

OBJECTIVES

The student should be made to:

- Learn about body area networks' and different hardware's related to it
- Provide knowledge in the applications of Body Area Networks..
- Understand the network topologies, protocols and standards used for BAN.
- Understand various issues during implementation of BAN.
- Know the various applications of BAN.

UNIT I: INTRODUCTION   9

Definition, BAN and Healthcare, Pervasive Patient Monitoring using BAN, Technical Challenges-Sensor design, biocompatibility, Energy Supply, System security and reliability, Context Awareness, Integrated Therapeutic Systems, Ideal BSN Architecture.

UNIT II: HARDWARE FOR BAN   9

Wireless communication - RF communication in Body, Antenna design and testing, Matching Network, Propagation, Materials, Base Station, Power considerations, Wireless communication technologies for wearable systems, Body Area Network — Human Applications.

UNIT III: NETWORK TOPOLOGIES, PROTOCOLS AND STANDARDS   9

Network Topologies - Stand –Alone BAN, Wireless personal Area Network Technologies. Standards - IEEE 802.15.1, IEEE P802.15.13, IEEE 802.15.14, Zigbee, Healthcare system standards.

UNIT IV: COEXISTENCE ISSUES WITH BAN   9

Interferences — Intrinsic - Extrinsic, Effect on transmission, Regulatory issues-Medical Device regulation in Asia, Security and Self protection-Bacterial attacks, Virus infection, secured protocols, Self protection.

UNIT V: APPLICATIONS OF BAN   9

Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrhymias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Smart Garments, Electronic pill.

TOTAL: 45 PERIODS

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OUTCOMES

Upon completion of the course, the students will be able to:

- Comprehend technical information and challenges in body area networks (BAN)
- Describe the hardware requirements of BAN
- Review the network topologies, protocols and standards used for BAN
- Understand various issues during implementation of BAN
- Discuss various applications of BAN.

TEXT BOOKS

1. Guang-Zhong Yang(Ed.), ―Body Sensor Networks, ―Springer, 2006.
2. Sandeep K.S. Gupta,Tridib Mukherjee,Krishna Kumar Venkatasubramanian, ―Body AreaNetworks Safety, Security, and Sustainability,‖ Cambridge University Press, 2013.

REFERENCES

1. Annalisa Bonfiglio, Danilo De Rossi ,"Wearable Monitoring Systems", Springer, 2011.
2. Zhang, Yuan-Ting, ―Wearable Medical Sensors and Systems‖,Springer, 2013.

E-RESOURCES :

1. https://nptel.ac.in/courses/106/105/106105160/
2. https://nptel.ac.in/courses/106/105/106105183/

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19MDPX09	MEDICAL EXPERT SYSTEMS	L T P C
		3 0 0 3

OBJECTIVES

The student should be made to:

- Develop informed opinions about the present and past opinion leaders in the artificial intelligence debate.
- Understand a simple, informal expert system by performing an effort of knowledge engineering of a real, human expert.
- Know the basic concepts of expert system architecture..
- Experience some actual hands-on demonstration software while accomplishing the reviewof current applications areas in AI.
- Explore different case studies on medical expert systems.

UNIT I: INTRODUCTION TO AI   **9**

Definition of AI – importance of AI – problem solving, searching, heuristic searching.

UNIT II: KNOWLEDGE REPRESENTATION   **9**

Preposition Logic – Clause form – Predicate logic – Resolution – Inference Rules – Unification –Semantic networks – frames – conceptual dependency – Scripts – knowledge representation using rules — rule based systems.

UNIT III: EXPERT SYSTEMS   **9**

Expert system architecture - non-production systems architecture– knowledge acquisition and validation - Knowledge system building tools.

UNIT IV: LEARNING & DECISION MAKING   **9**

Types of learning — general learning model — learning by induction — generalization & specialization – inductive bios – explanation based learning.

UNIT V: CASE STUDY   **9**

Study of medical expert systems – MYCIN, EMYCIN - development of medical expert systems –sample Case studies.

                                                                      TOTAL: 45 PERIODS

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OUTCOMES

Upon completion of the course, the students will be able to:

- Explain the role of Artificial Intelligence, Expert Systems and Decision Models in managerial decision-making.

- Apply, build and modify decision models to solve real problems

- Design and develop Artificial Intelligence Based Decision Support Systems and discuss the role of these systems play in the business environment.

- Explain Artificial Intelligence Techniques in decision making.

- Build a prototype Artificial Intelligence based medical expert system.

TEXT BOOKS

1. Dan W. Patterson, ―Introduction to Artificial Intelligence and Expert Systems‖, Prentice Hall of India, Delhi, 2001.

2. Watterman. ―Expert Systems‖, Mc-Graw Hill, New York, 1991.

REFERENCES

1. George F Luger, ―Artificial Intelligence, structures and strategies for complex problem solving‖, Pearson Education Delhi, 2001.

2. Elain Rich and Kevin Knight, ―Artificial Intelligence‖, 2nd edition, Tata Mc Graw Hill, 1993.

E-RESOURCES :

1. https://tkiet.digimat.in/nptel/courses/video/106106140/L79.html

2. https://www.digimat.in/nptel/courses/video/106106140/L33.html

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19MDPX10	IoT IN HEALTHCARE	L T P C
		3 0 0 3

OBJECTIVES

The student should be made to:

- Understand the fundamentals of IoT.
- Know the basic concepts of medical big data.
- Explore various challenges in IoT.
- Learn the AI applications in Health Industry.
- Study the health care applications through IoT tools.
- Design a IoT application system for better patient care

UNIT I: OVERVIEW OF INTERNET OF THINGS   9

Introduction-Healthcare architecture in Internet of Things-Communication between devices-Medical body area networks-Architecture Requirements-Healthcare Ecosystem– Health Care Applications using IoT– Health Application Requirements– Opportunities And Challenges.

UNIT II: MEDICAL BIG DATA   9

Big Data dimensions Big Data for Medical Industry– Information Processing in Health Care Analytics– Data Mining Process for Medical Big Data– Medical Big Data Analytics– Medical Big Data- Applications and Challenges.

UNIT III: IoT TECHNOLOGIES AND CHALLENGES   9

IoMT system Architecture– Components of system architecture– IoT Healthcare solutions– Enhanced medicine management– Technologies used in IoT-based applications.

UNIT IV: AI IN BIOMEDICINE   9

AI and Computer Vision in biomedicine-Principal Disciplines of AI and Computer Vision-Machine learning– Classification and Regression– Predictive Analysis. Biomedical applications and solutions-Medical Imaging– Pattern Recognition– Abnormality Detection.

UNIT V: IoT IN HEALTHCARE APPLICATIONS   9

IoT based smart and secure health monitoring system– Development of obstacle avoiding robots based on sensors and IoT– Patient health monitoring system using Arduino and Android– detection of atrial fibrillation– fall detection using IoT technologies.

TOTAL: 45 PERIODS

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OUTCOMES

Upon completion of the course, the students will be able to:

- Discuss the concepts of Internet of Things.

- Interpret Big Data for Medical Industry.

- Illustrate the need and challenges of IoT.

- Relate AI applications in Industry domain and analyze their performance.

- Compute the health care applications through IoT tools and Embedded systems.

- Enable healthcare professionals to be more watchful and connect with the patients proactively

TEXT BOOKS

1. Valentina E. Balas, Le Hoang Son, "Internet of Things in Biomedical Engineering", Academic Press,1 st Edition, 2019.

2. Chintan Bhatt, Nilanjan Dey, "Internet of Things and Big Data Technologies for Next Generation Healthcare", SpringerTechnology & Engineering, 2017.

REFERENCES

1. Nilanjan Dey, Amira S. Ashour, "Wearable and Implantable Medical Devices: Applications and Challenges", Academic Press,1 st Edition, 2019.

2. Singh, Rajesh, Gehlot, Anita, Jain, Vishal, Malik, Handbook of Research on the Internet of Things Applications in Robotics and Automation, IGI Global,1 st Edition, 2019.

E-RESOURCES :

1. NPTEL Videos https://nptel.ac.in/courses/106/105/106105166/ "Introduction to IoT",Prof.Sudip Misra, IIT Kharagpur

2. NPTEL Videos https://freevideolectures.com/course/4638/nptel-introduction-internet-things/58 " Case Study: Healthcare" Prof.Sudip Misra, IIT Kharagpur

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PROFESSIONAL ELECTIVE-III

19MDPX11	REHABILITATION ENGINEERING	L T P C
		3 0 0 3

OBJECTIVES

The student should be made to:

- Learn the basics of rehabilitation engineering
- Study about principle of rehabilitation engineering.
- Understand different types of Therapeutic Exercise Technique.
- Understand the tests to assess the hearing loss and development techniques of electronic devices for visually and auditory impaired.
- Study about various orthopaedic devices and prosthetic devices
- Have an understanding of rehabilitation medicine and advocacy..

UNIT I: INTRODUCTION TO REHABILITATION   **9**

Definition–Concept of Rehabilitation: Types of Physical Impairments, Principles of Assistive Technology Assessment, Principles of Rehabilitation Engineering- Key Engineering Principles– Key Ergonomic Principles– Engineering Concepts in Sensory & Motor rehabilitation..

UNIT II: ORTHOTICS & PROSTHETICS IN REHABILITATION   **9**

Types of orthosis-FO,AFO,KAFO,HKAFO and prosthesis ,Partial Foot Prostheses- Foot-ankle assembly–Transfemoral Prostheses– Prosthetic Hand– Advance and automated prosthetics and orthosis– Externally powered and Controlled orthotics & prosthetics – FES system– Restoration of Hand function–Restoration of standing and walking.

UNIT III: MOBILITY AIDS   **9**

Electronic Travel Appliances (ETA) : Path Sounder, Laser Cane, Ultrasonic Torch, Sonic Guide, Light Probes, Nottingham Obstacle Sensors, Electro cortical Prosthesis, Polarized Ultrasonic Travel aids. Materials used for wheel chairs– Type of Wheel Chairs– design of wheel Chair– Walking frames– Parallel bars– Rollators – Quadripods– Tripods & walking sticks– Crutches.

UNIT IV: AUDITORY AND SPEECH ASSIST DEVICES   **9**

Types of deafness– hearing aids– application of DSP in hearing aids– Cochlear implants– Voice synthesizer– speech trainer .

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UNIT V: SENSORY AUGMENTATION AND SUBSTITUTIONS   **9**

Classification of Visual Impairments– Prevention and cure of visual impairments– Visual Augmentation– Tactile vision substitution– auditory substitution and augmentation– tactile auditory substitution– Assistive devices for the visual impaired.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Understand the key terminologies used by the rehabilitation team.
- Device new concepts for future development and applications.
- Design and develop different sensory assist devices, orthotics and prosthetics for rehabilitation applications.
- Understand the need of virtual reality tools for different aids
- Appreciate the legal aspects for building rehabilitation aids for the neededpeople

TEXT BOOKS

1. Joseph D.Bronzino, "The Biomedical Engineering Handbook", 3 rd Edition: Three Volume Set, CRC Press,2006.
2. Raymond V. Smith, "Rehabilitation Engineering", CRC press, Reprint 2018.

REFERENCES

1. Xingdong Zhang, David Williams, "Definitions of Biomaterials for the Twenty-First Century", Elsevier, 2019.
2. Joseph Webster, Douglas Murphy, "Atlas of Orthoses and Assistive Devices", Elsevier, 5 th Edition,   2017.

E-RESOURCES :

1. https://swayam.gov.in/nd2_aic19_ge01/preview, "Development of Assistive technology for persons with Disabilities", Indumathi Rao, C B R Network
2. https://www.resna.org/Resources/Research-Guidelines   "RESNA's   Guidelines   and Priorities for AssistiveTechnology and Rehabilitation Research".

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19MDPX12	VIRTUAL REALITY IN MEDICINE	L T P C
		3 0 0 3

OBJECTIVES

The student should be made to:

- Introduce the relevance of this course to the existing technology through demonstrations case studies and applications with a futuristic vision along with socio-economic impact and issues

- Understand virtual reality, augmented reality and using them to build Biomedical engineering applications

- Know the intricacies of these platform to develop PDA applications with better optimality

- Impart the fundamental aspects, principles of virtual reality technology

- Gain knowledge about applications of virtual reality

UNIT I: INTRODUCTION   9

The three I's of virtual reality-commercial VR technology and the five classic components of a VR system - Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation-interfaces and gesture interfaces-Output Devices: Graphics displays-sound displays & haptic feedback.

UNIT II: VR DEVELOPMENT PROCESS   9

Geometric modeling - kinematics modeling- physical modeling - behaviour modeling - model Management.

UNIT III: CONTENT CREATION CONSIDERATIONS FOR VR   9

Methodology and terminology-user performance studies-VR health and safety issues-Usability of virtual reality system- cyber sickness -side effects of exposures to virtual reality environment.

UNIT IV: VR ON THE WEB & VR ON THE MOBILE   9

JS-pros and cons-building blocks (WebVR, WebGL, Three.js, device orientation events)-frameworks (A-frame, React VR)-Google VR for Android-Scripts, mobile device configuration, building to android-cameras and interaction-teleporting-spatial audio-Assessing human parameters-device development and drivers-Design Haptics.

UNIT V: APPLICATIONS   9

Medical applications-military applications-robotics applications- Advanced Real time Tracking other applications- games, movies, simulations, therapy.

TOTAL: 45 PERIODS

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OUTCOMES

Upon completion of the course, the students will be able to:

- Summarize the significance and role of this course in the present contemporary world
- Understand the basic concepts of Virtual reality
- Outline the Virtual Reality applications in different areas
- Analyze & Design a system or process to meet given specifications with realistic engineering constraints.
- Identify problem statements and function as a member of an engineering design team.
- Utilize technical resources
- Propose technical documents and give technical oral presentations related to design mini project results

TEXT BOOKS

1. C. Burdea & Philippe Coiffet, "Virtual Reality Technology", Second Edition, Gregory, John Wiley & Sons, Inc.,2008.
2. Jason Jerald. 2015. The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool, New York, NY, USA.

REFERENCES

1. Augmented Reality: Principles and Practice (Usability) by Dieter Schmalstieg & Tobias Hollerer, Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016. ISBN: 9780321883575.
2. Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability),Steve Aukstakalnis, Addison-Wesley Professional; 1 edition, 2016.

E-RESOURCES :

1. https://youtu.be/aNC5YMUTcQ4, Virtual Reality by Prof Steven LaValle, Visiting Professor
2. https://youtu.be/f-vUixm-YlQ, Goals and VR definitions, Virtual Reality by Prof Steven LaValle, Visiting Professor".

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19MDPX13	**ADVANCED MEDICAL IMAGE ANALYSIS**	**L T P C**
		3 0 0 3

OBJECTIVES

The student should be made to:

- Learn how to implement, debug and test functionality in Matlab

- Optimize algorithms for medical imaging. Learn about sources of noise in medical images (i.e. Acquisition noise, low contrast), and how to reduce their impactthrough denoising and enhancement

- Learn how to design and implement automated medical analysis algorithms on clinical imaging data using Matlab

- Perform research on an image analysis algorithm that has practical utility in hospitals

- Medical image segmentation the aim is to study anatomical structure.

- Transform descriptions of medical diagnoses or procedures into standardized statistical code in a process known as clinical coding

UNIT I: INTRODUCTION TO MEDICAL IMAGING   9

Introduction to Medical Imaging and Analysis Software, X-ray and Computed Tomography (CT) imaging**,** Magnetic Resonance Imaging (MRI), Ultrasonic Imaging**,** Molecular Imaging, SPECT and PET.

UNIT II: STEPS IN IMAGE PROCESSING   9

Texture in Medical Images, Region Growing and Clustering, Random Walks for Segmentation, Active Contours for Segmentation, Systematic Evaluation and Validation.

UNIT III: IMAGE SEGMENTATION & ANALYSIS   9

Image Segmentation: Decision Trees for Segmentation and Classification and Random Forests for Segmentation and Classification. Image Analysis: Neural Networks for Segmentation and Classification and Deep Learning for Medical Image Analysis.

UNIT IV: DEEP LEARNING FOR IMAGE ANALYSIS   9

Advanced Computer Vision - Neural Networks for Image Processing – Overview of Deep Neural Networks - Convolutional Neural Networks and Deep Learning for Medical Image Analysis.

UNIT V: APPLICATIONS   9

Retinal Vessel Segmentation, Vessel Segmentation in Lung CT Image, Lesion Segmentation in Brain MRI.

TOTAL: 45 PERIODS

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OUTCOMES

Upon completion of the course, the students will be able to:

- Indicate digital image fundamentals

- Apply image enhancement techniques for processing images

- Select the methodologies for image segmentation & recognition.

- Outline the deep learning techniques in practical applications

- Attribute image restoration and reconstruction techniques in real time applications.

TEXT BOOKS

1. Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2011.

2. William K. Pratt, "Introduction to Digital Image Processing", CRC Press, 2013.

REFERENCES

1. Wolfgang Birkfellner, "Applied medical Image Processing- A basic course", Second Edition, CRC Press, 2014.

2. Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", Fourth Edition,Pearson Education, 2018.

E-RESOURCES :

1. https://youtu.be/9QIZ-zrkgYk, Medical Image Analysis - Introduction

2. https://youtu.be/T0cARCkh2To, Image analysis - Introduction and image mapping.

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19MDPX14 **COMPUTATIONAL NEUROSCIENCE** **L T P C**
3 0 0 3

OBJECTIVES

The student should be made to:

- Describe how the brain computes
- Describe different methods that computational neuroscientists use to model neural
- coding, both dynamically and over time
- Computationally model the biophysics of single neurons
- Computationally model the dynamics of networks of neurons
- The ultimate goal of computational neuroscience is to explain how electrical and chemical signals are used in the brain to represent and process information

UNIT I: BASICS OF NEURON STRUCTURE AND FUNCTIONS   9

Nervous system development. Trophic factors, extra cellular matrix components in nervous system development. Neuron: structure – function – classification. Glial cells – myelination. Neurotransmitter – types and functions. Synapses - Transport of materials and impulse in Neurons.

UNIT II: BRAIN, BRAIN STEM AND SPINAL CORD   9

Brain: structures – lobes – functional areas. Brain stem: structures – functional areas. Spinal cord: structure – functions. Concepts of nuclei – sensory and motor Tracts - Reticular formation. Blood supply to Brain and spinal cord.

UNIT III: NEURONAL DISEASES AND DISORDERS   9

Neuro degeneration: Degenerative, Demyelinated and injury related disorders associated with nervous system. Wallerian Degeneration.Neuronal plasticity – CNS acting drugs and their pharmacokinetics. Alzheimer's, Parkinson's and Prion diseases.

UNIT IV: NEUROPHYSIOLOGY & NEURORADIOLOGY   9

Neural plasticity; Neurological dysfunctions - Regeneration of the peripheral nervous system. Neural tissue engineering; Nerve graft; Drug delivery system in CNS. Rehabilitation: Mechanisms for Neuromotor rehabilitation; Robotics and virtual reality in physical therapy; Transcranial magnetic stimulation.

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UNIT V: APPLICATIONS 9

Neural plasticity; Neurological dysfunctions - Regeneration of the peripheral nervous system. Neural tissue engineering; Nerve graft; Drug delivery system in CNS. Rehabilitation: Mechanisms for Neuromotor rehabilitation; Robotics and virtual reality in physical therapy; Transcranial magnetic stimulation.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Explain the basic structure and functions of human nervous system.
- Understand the concepts on brain, brain stem and spinal cord
- Analyse diseases and degeneration related to nervous system
- Structure the visualization and radiological assessment of nervous system
- Attribute the concept on neural tissue engineering for rehabilitation & Regeneration of nervous system.

TEXT BOOKS

1. Michael J. Aminoff, "Aminoff's Electrodiagnosis in Clinical Neurology", Sixth Edition, Elsevier Saunders, 2012.
2. Eric R. Kandel, James H. Schwartz, Thomas M. Jessell, Steven A. Siegelbaum, A. J. Hudspeth, Sarah Mack, "Principles of Neural Science", McGraw-Hill, New York,2012.

REFERENCES

1. Raymond Cooper, Colin D. Binnie, Richard Billings, "Techniques in Clinical Neurophysiology: A Practical Manual", Elsevier, Amsterdam, the Netherlands, 2005.
2. Holodny, Andrei I, "Functional neuroimaging: a clinical approach", Informa Health Care, CRC Press; 1st edition, 2008.

E-RESOURCES :

1. http://en.wikipedia.org/wiki/, Computational neuroscience
2. http://www.scholarpedia.org/article/, Encyclopedia_of_computational_neuroscience

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19MDPX15   **CARDIOVASCULAR ENGINEERING**   **L T P C**
                                                          3 0 0 3

OBJECTIVES

The student should be made to:

- Understand the basics of cardiovascular system

- Analyze events of cardiac cycle

- Learn hemodynamics of cardiac systems

- Provide answers to life-saving clinical questions using engineering approaches.

- Improve our understanding of cardiovascular disease and develop better therapies.

- Develop new methods to study, diagnose and treat cardiovascular diseases

UNIT I: OVERVIEW OF THE CARDIOVASCULAR SYSTEM   9

Functions of the cardiovascular system, Circulation of blood, Central control of the cardiovascular system.

UNIT II: CARDIAC CYCLE   9

Mechanical events, Arterial cycle and central venous pressure cycle, Clinical aspects of human cardiac cycle.

UNIT III: CARDIAC EXCITATION AND CONTRACTION   9

Mechanism of contraction, Sinoatrial node function, cardiac conduction system, Atrioventricular node function, Autonomic regulation of the heart rate.

UNIT IV: ASSESSMENT OF CARDIAC OUTPUT   9

Fick principle, Thermodilution and indicator dilution methods, Pulse Doppler methods, miscellaneous methods.

UNIT V: HEMODYNAMICS   9

Relationship between pressure, flow and resistance, Frank-Starling law, Preload, afterload and contractility, Control of stroke volume and cardiac output.

TOTAL: 45 PERIODS

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OUTCOMES

Upon completion of the course, the students will be able to:

- Explain the overview of cardiovascular system.

- Illustrate the cardiac cycle

- Analyse the cardiac Excitation and contraction

- Assess the cardiac output for various events

- Attribute the concepts on Hemodynamics

- Analyse the overall concept of Cardiovascular Engineering

TEXT BOOKS

1. Susan J Hall, "Basics of Biomechanics", Mc Graw Hill Publishing.co. New York, 8th Edition, 2018.

2. Dhanjoo N.Ghista, "Orthopaedic Mechanics", Academic Press, 2014

REFERENCES

1. Joseph D.Bronzino, "Biomedical Engineering Fundamentals", Taylor& Francis, 2006.

2. John Enderle, Susanblanchard, Joseph Bronzino, "Introduction to Biomedical Engineering", Elsevier, 2005.

E-RESOURCES :

1. https://youtu.be/6BWSpen-obc, An Introduction to Cardiovascular Fluid Mechanics- Prof. Raghvendra Gupta

2. https://youtu.be/vOY9sg3DGC4, Fluid Mechanics: A Review

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ESTD 2001

PROFESSIONAL ELECTIVE-IV

19MDPX16	CLINICAL TRAILS	L T P C
		3 0 0 3

OBJECTIVES

The student should be made to:

- establish the safety and effectiveness of specific health and medical products and practices

- Analyze different clinical trial designs.

- Identify the Randomized trials to assure that each individual has an equal probability to be assigned to one or the other treatment

- Identify data points that provide insight into operational performance.

- Understand the focuses on the use and governance of individual's personal data like making policies.

- Establish authorization requirements to ensure that patients personal information is being collected, shared and utilized in right ways

UNIT I: BASIC CONCEPTS IN CLINICAL RESEARCH   9

Basics of epidemiology, Definition, scope, and uses of epidemiology Measures of disease and death frequency, Mortality and morbidity, epidemiological study designs, Observational studies, descriptive studies, experimental studies, Ecological studies, cross sectional studies, cohort studies, case control studies, incidence, prevalence, odds ratio, relative risk, ethical and regulatory aspects of clinical research, ethical issues in preclinical (animal studies and clinical studies).

UNIT II: CLINICAL TRIAL DESIGNS   9

Basics of Clinical Trials: need clinical trials, Brief History of Clinical Trials, Glossary of Common Terms in clinical Trials: Clinical Research, Healthy Volunteer, Inclusion/Exclusion Criteria, Informed Consent, Patient Volunteer, Phases of Clinical Trials, Placebo, Protocol, Principal Investigator, Randomization, Single- or Double-Blind, Studies, Types of Clinical Trials. - Diagnostic trials, Natural history studies, Prevention trials, Quality of life trials, Screening trials, Treatment trials. Clinical Trial Protocol and its components. Type of analyses: ITT, and PP.

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UNIT III: RANDOMIZED CONTROLLED TRAIL   9

Randomized controlled trial - Reasons for randomization, Features of RCT – design and conduct of RCT - Random allocation, Allocation concealment, Blinding, Conduct, Outcome ascertainment, Sample size, Power of a study. Reporting of RCT- Randomization and Masking, Overview of Clinical Study Design.

UNIT IV: MANAGEMENT OF CLINICAL DATABASE   9

Clinical Trials Metrics Collection, Clinical Data Management, Data Processing – Database - Definition of Data Management and its benefits -Types of data: data collection methods, raw, physical collection, models, images etc. –Data entry - File naming – Data assurance: quality control and assurance of data, medical coding, dictionary management and maintenance of quality documents.

UNIT V: DATA SAFETY   9

Missing data, submitting data, Metadata: Metadata standards, submitting Data, File formats, preserve: Backup of data, Migration: Transformation of data, discovering data, Integrate: Merging of multiple data sets, Data Citation, Data retrieval, Archiving, Double data entry and checking, Quality control and Data Cleaning

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Narrate the importance of spreading and measurement of disease..
- Discuss the terms, phases of clinical trails and study of different clinical trails
- Describe the features and different methods of randomized control trail
- Categorize the different types of data and its managemnt in clinical trails
- Summarize the types of file format for the safety maintenance of data
- Analyse the overall concept of Cardiovascular Engineering

TEXT BOOKS

1. P. Michael Dubinsky, Karen A. Henry "The fundamentals of clinical research: A universal guide for implementing good clinical practice" wiley , 2021.

2. Lawrence M. Friedman, Curt D. Furberg, David L. DeMets, David M. Reboussin, Christopher B. Granger " Fundamentals of clinical trails" Springer Cham, Edition:5 , 2015

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REFERENCES

1. David machin, simon day, and sylvan green " Text book of clincal trails" Wiley , 2014.

2. "Hand book for good clinical research practice (GCP) : Guidance for implementation", WHO Library Cataloguing-in-Publication Data 2005.

E-RESOURCES :

1. https://youtu.be/DauygxZJ4EQ - Current regulatory requirements for conducting clinical trials in India for investigational new drugs/new drug

2. https://youtu.be/ZTu8OHlpJw0 - Introduction to health research

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19MDPX17	TELEHEALTH TECHNOLOGY	L T P C
		3 0 0 3

OBJECTIVES

The student should be made to:

- Learn the key principles for telemedicine and health
- Understand telemedical technology.
- Know telemedical standards, mobile telemedicine and it applications.
- Make services more easily offered or handy for people who have limited ability to move, time or transportation
- Improve communication and coordination of care among health care team
- Connecting physicians in one area with patients in another using networking devices

UNIT I: FUNDAMENTALS OF TELEMEDICINE   9

History of telemedicine, definition of telemedicine, tele-health, tele-care, scope, Telemedicine Systems, benefits & limitations of telemedicine.

UNIT II: TYPE OF INFORMATION & COMMUNICATION INFRASTRUCTURE FOR TELEMEDICINE   9

Audio, video, still images, text and data, fax-type of communications and network: PSTN, POTS, ANT, ISDN, internet, air/ wireless communications, GSM satellite, micro wave, Mobile health and ubiquitous healthcare.

UNIT III: ETHICAL AND LEGAL ASPECTS OF TELEMEDICINE   9

Confidentiality, patient rights and consent: confidentiality and the law, the patient-doctor relationship, access to medical records, consent treatment - data protection & security, jurisdictional issues, intellectual property rights.

UNIT IV: PICTURE ARCHIVING AND COMMUNICATION SYSTEM   9

Introduction to radiology information system and ACS, DICOM, PACS strategic plan and needs assessment, technical Issues, PACS architecture.

UNIT V: APPLICATIONS OF TELEMEDICINE   9

Teleradiology, telepathology, telecardiology, teleoncology, teledermatology, telesurgery, e Health and Cyber Medicine.

TOTAL: 45 PERIODS

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OUTCOMES

Upon completion of the course, the students will be able to:

- Apply multimedia technologies in telemedicine
- Explain protocols behind encryption techniques for secure transmission of data
- Apply telehealth in healthcare.
- Have the potential to improve the quality of health care
- communicate and coordinate among health care team
- Integrate patients using network devices.

TEXT BOOKS

1. Norris A C, "Essentials of Telemedicine and Telecare", John Wiley, New York, 2002.
2. H K Huang, "PACS and Imaging Informatics: Basic Principles and Applications" Wiley, New Jersey, 2010

REFERENCES

1. Olga Ferrer Roca, Marcelo Sosa Iudicissa, "Handbook of Telemedicine", IOS Press, Netherland, 2002.
2. Khandpur R S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2003.

E-RESOURCES :

1. https://in.coursera.org/lecture/healthcare-it-operations-patient-safety/introduction-to-telemedicinen0JK5?utm_source=link&utm_medium=page_share&utm_content=vlp&utm_campaign=top_button , Introduction to Telemedicine
2. https://youtu.be/x9un_bieIjA , Best Practices in Global Telehealth and Tele-education

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19MDPX18   PATTERN RECOGNITION TECHNIQUES AND ITS APPLICATIONS   L T P C

3 0 0 3

OBJECTIVES

The student should be made to:

- Understand the pattern recognition system and its types.

- Be familiar with the statistical and syntactic approach

- Understand the different knowledge representation schemes for AI problems.

- Explore different search strategies for a problem.

- pattern Recognition is the recognizable proof of verifiable items and relations

- Pattern recognition can be defined as the classification of data based on knowledge already gained or on statistical information extracted from patterns and/or their representation

UNIT I: PATTERN CLASSIFIER   9

Overview of Pattern recognition – Discriminant functions – Supervised learning – Parametric estimation – Maximum Likelihood Estimation – Bayesian parameter Estimation – Problems with Bayes approach– Pattern classification by distance functions – Minimum distance pattern classifier.

UNIT II: CLUSTERING   9

Clustering for unsupervised learning and classification – Clustering concept –Hierarchial clustering, Partitional clustering- k-means algorithm – Validity of Clusters.

UNIT III: FEATURE EXTRACTION AND STRUCTURAL PATTERN RECOGNITION   9

KL Transforms – Feature selection through functional approximation – Binary selection - Elements of formal grammars - Syntactic description - Stochastic grammars - Structural representation.

UNIT IV: HIDDEN MARKOV MODELS AND SUPPORT VECTOR MACHINE   9

State Machines – Hidden Markov Models – Training – Classification – Support vector Machine – Feature Selection.

UNIT V: RECENT ADVANCES AND APPLICATIONS   9

Fuzzy logic – Fuzzy Pattern Classifiers – Case Study Using Fuzzy Pattern Classifiers CAD system in breast cancer detection, ECG signal classification, Fingerprint recognition, cell cytology classification.

TOTAL: 45 PERIODS

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OUTCOMES

Upon completion of the course, the students will be able to:

- Explain the concept of pattern recognition and its different phases

- Implement the statistical and syntactic approach of Pattern recognition

- Apply the heuristic concepts to develop intelligent system

- Analyse the overall concepts of pattern recognition

- Understand the different knowledge representation schemes for AI problems.

- Understand the different search strategies for a problem.

TEXT BOOKS

1. Robert Schalkoff, Pattern Recognition: Statistical Structural and Neural Approaches,Wiley – India, 2009.

2. Artificial Intelligence: A new synthesis, Nils J Nilsson, Morgan Kaufmann Publishers

REFERENCES

1. R.O.Duda, P.E.Hart and D.G.Stork, "Pattern Classification", John Wiley, 2001.

2. Artificial Intelligence, 2nd ed., Rich, Tata McGraw Hill. 3. Artificial Intelligence, R.B. Mishra, PHI, India, 2010.

E-RESOURCES :

1. https://youtu.be/U5xsX2ersHQ **,** Pattern Recognition Techniques and Its Applications

2. https://youtu.be/Z66_2_VG_k8 , Introduction to Statistical Pattern Recognition

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19MDPX19   **BRAIN COMPUTER INTERFACE AND ITS APPLICATIONS**   **L T P C**
                                                                          3 0 0 3

OBJECTIVES

The student should be made to:

- Introduce the basic concepts of brain computer interface
- Design classifier for a BCI system
- Build a communication bridge between human brain and the external world eliminating the need for typical information delivery methods.
- Know about the signal processing methods used in brain computer interface
- Study the various signal acquisition methods
- Analyze the recent applications in BCI

UNIT I: INTRODUCTION TO BCI   9

Fundamentals of BCI – Structure of BCI system – Classification of BCI: Invasive, Could Anyone Use a BCI?, Non-invasive and Partially invasive BCI- Brain signal acquisition, Signal Preprocessing, Artifacts removal.

UNIT II: ELECTROPHYSIOLOGICAL SOURCES   9

Sensorimotor activity –Neuronal activity in motor cortex and related areas- Electric andmagnetic fields produced by the brain- signals reflecting brain metabolic activity- Mu rhythm, Movement Related Potentials – Slow Cortical Potentials - P300 Event related potential – Visual Evoked Potential - Activity of Neural Cells - Multiple Neuro-mechanisms.

UNIT III: FEATURE EXTRACTION METHODS   9

Time/Space Methods – Fourier Transform, Wavelets, AR, MA, ARMA models, Bandpassfiltering, Template matching, Kalman filter, PCA, Laplacian filter – Linear and Non-Linear Features.

UNIT IV: FEATURE TRANSLATION METHODS   9

Linear Discriminant Analysis –Nearest neighbours, Support Vector Machines - Regression – Learning Vector Quantization – Gaussian Mixture Modeling – Hidden Markov Modeling – Neural Networks.

UNIT V: APPLICATIONS OF BRAIN-COMPUTER INTERFACES   9

Introduction, - BCIs for Assistive Technology – BCIs for Recreation - BCIs for Cognitive Diagnostics and Augmented Cognition - Rehabilitation and Prosthetics, Functional Near-Infrared Sensing (fNIR) and Environmental Control Applications - Near Infrared Sensing Technology – The OTIS System – Basic BCI Application – Environmental Control with fNIR, Brain-Computer

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Interfacing and Games – Introduction - Human-Computer Interaction for BCI - BCI for Controlling and Adapting Games, Direct Neural Control of Anatomically Correct Robotic Hands, Software Tools for BCI Research - Introduction – Data Streaming – Online DataProcessing - Ethical Issues in BCI Research.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Interpret and analyze the signal processing methods used in BCI
- Implement BCI for various applications
- Acquire the brain signal in the format required for the specific application
- Preprocess the signal for signal enhancement
- Extract the dominant and required features
- Classify the signal for applications.

TEXT BOOKS

1. S. Coyle, T. Ward et al, ―On the suitability of near infra-red systems for next generation Brain Computer interfaces‖, Physiological Measurement, 25, 2004.

2. Jose del R. Millan et al, ―Non-invasive brain actuated control of a mobile robot by human EEG‖, IEEE Transactions on biomedical Engineering, Vol 51, No.6, 2004 June

REFERENCES

1. Andrew Webb, ―Statistical Pattern Recognition‖, Wiley International, Second Edition, 2002.

2. Special Issue on Brain Control Interfaces, IEEE Transactions on Neural Systems and Rehabilitation Engineering, Vol 14, June 2006.

E-RESOURCES :

1. http://www.emotiv.com/bci-guide/ "The Introductory Guide to BCI

2. https://nptel.ac.in/courses/106/105/106105215/ "Deep Learning", Prof. Prabir Kumar Biswa, Department of Electronics and Electrical Communication Engineering, IIT Kharagpur

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19MDPX20   **BIOMETRIC SYSTEMS**   **L T P C**

3 0 0 3

OBJECTIVES

The student should be made to:

- get knowledge on the technologies involved in fingerprint,iris,face and speech recognition
- Capture an item of biometric data from this person
- recognize personal privacy and security implications in biometric based identification system
- develop biometric systems by minimizing the underlying trade-offs.
- Enhance the security infrastructure in the industry and generally in information sensitive environments

UNIT I: INTRODUCTION TO BIOMETRICS   9

Biometric Technologies– passive and active biometrics– Biometrics and traditional techniques. Biometric characteristics– Biometric applications – Biometric Authentication systems- Taxonomy of Application Environment– Performance and Accuracy measures in Biometric Systems–False match rate- False nonmatch rate- Failure to enroll rate– Derived metrics-Biometrics and Privacy.

UNIT II: FINGERPRINT IDENTIFICATION TECHNOLOGY   9

General description of fingerprints- fingerprint capture & sensors– fingerprint enhancement– Feature Extraction Ridge orientation– ridge frequency– fingerprint matching techniques- correlation based– Minutiae based– Ridge feature based– fingerprint classification– Applications of fingerprints– Finger scan - strengths and weaknesses– Evaluation of fingerprint verification algorithms. Fingerprints in forensics and biometrics– similarities and differences.

UNIT III: FACE RECOGNITION   9

Introduction to face recognition– face recognition using PCA– LDA– face recognition using shape and texture– face detection in color images–3Dmodel based face recognition in video images– Neural networks for face recognition– Hand geometry – scanning – Feature Extraction – classification.

UNIT IV: IRIS RECOGNITION   9

Introduction– Anatomical and Physiological underpinnings– Iris sensor– Iris representation and localization– Daugman and Wilde's approach– Iris matching– Iris scan strengths and Weaknesses– System performance– future directions.

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UNIT V: VOICE SCAN AND MULTIMODAL BIOMETRICS **9**

Voice scan speaker features, short term spectral feature extraction, Mel frequency cepstral coefficients, speaker matching, Gaussian mixture model, NIST speaker Recognition Evaluation Program, Introduction to multimodal biometric system – Integration strategies – Architecture – level of fusion – combination strategy, examples of multimodal biometric systems.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Demonstrate the knowledge on principles of biometrics system.
- Understand the feature extraction, classification techniques andapplicationsof fingerprint technology.
- Discuss about the techniques involved in face recognition biometric system.
- Design iris recognition system.
- Develop speech recognition and multimodal biometric systems.

TEXT BOOKS

1. James Wayman& Anil Jain, "Biometric Systems- Technology Design and Performance Evaluation", Springer, First Edition, 2011.
2. John R. Vacca, "Biometric Technologies and Verification Systems", First Edition Elsevier, 2007

REFERENCES

1. G.R.Sinha, Sandeep B.Patel, "Biometrics: Concepts and Applications", Wiley Publications, First edition,2013.
2. Paul Reid, "Biometrics for Network Security", Pearson Education, 2004.

E-RESOURCES :

1. NPTEL Video https://nptel.ac.in/courses/106/104/106104119/ "Biometrics ",Prof. Phalguni Gupta, IIT Kanpur
2. https://ieeexplore.ieee.org/document/8851272/ Libing Wu, IEEE Transactions onInformation Forensics and Security

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PROFESSIONAL ELECTIVE-V

19MDPX21   **PHYSIOLOGICAL MODELING**   **L T P C**

                                                          3 0 0 3

OBJECTIVES

The student should be made to:

- Explain the application of Physiological models and vital organs.

- Formulate the methods and techniques for analysis and synthesis of dynamic models

- Describe the dynamic models, simulate and visualize, dynamic responses of physiological models using software.

- Describe nonlinear models of physiological systems

- Compute the Simulation of physiological systems

- Show how physiological problems can be formulated mathematically, and how such models can be used for analysis, prediction, and therapy design

UNIT I: INTRODUCTION TO PHYSIOLOGICAL MODELING   9

Approaches to modeling: The technique of mathematical modeling, classification of models, characteristics of models. Time invariant and time varying systems for physiological modeling. Introduction to physiology (homeostasis, cell biology) Modeling physical systems, linear models of physiological systems, the Laplace transform, Transfer functions and block diagram analysis Physiology.

UNIT II: MODELING OF DYNAMIC PHYSIOLOGICAL SYSTEM   9

Dynamic systems and their control, modeling and block diagrams, the pupil control systems(Human Eye), general structure of control systems, the dynamic response characteristics of the pupil control system, open &close loop systems instability, automatic aperture control.

UNIT III: NONLINEAR MODELS OF PHYSIOLOGICAL SYSTEMS   9

Nonparametric Modeling-Volterra Models. Wiener Models. Efficient Volterra Kernel Estimation. Parametric Modeling- Basic Parametric Model Forms and Estimation Procedures- Volterra Kernels of Nonlinear Differential Equations. Discrete-Time Volterra Kernels of NARMAX Models..

UNIT IV: COMPARTMENTENTAL PHYSIOLOGICAL MODEL   9

Modeling the body as compartments, behaviour in simple compartmental system, pharmacokinetic model, and multi compartmental system. Physiological modeling: Electrical analogy of blood vessels, model of systematic blood flow and model of coronary circulation.

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Mathematical modeling of the system: Thermo regulation, Thermoregulation of cold bloodedness& warm bloodedness, the anatomy of thermo regulation, lumping & partial differential equations, heat transfer examples, mathematical model of the controlled process of the body.

UNIT V: SIMULATION OF PHYSIOLOGICAL SYSTEMS   9

Simulation of physiological systems using Open CV / MATLAB software. Biological receptors: - Introduction, receptor characteristics, transfer function models of receptors, receptor and perceived intensity. Neuromuscular model, Renal System, Drug Delivery Model

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Explain the application of Physiological models..
- Describe the methods and techniques for analysis and synthesis of Linear and dynamic system
- Develop differential equations to describe the compartmental physiological model
- Describe Nonlinear models of physiological systems
- Illustrate the Simulation of physiological systems
- The physiological approach allows prediction of the change in drug outcome due to alteration of organ function

TEXT BOOKS

1. Michel C Khoo, ‑Physiological Control Systems ‑Analysis, simulation and estimation‖, Prentice Hall of India, 2001.
2. Marmarelis, ‑Nonlinear Dynamic Modeling of Physiological Systems‖, Wiley‑IEEE Press, 2004

REFERENCES

1. Benjamin C Kuo, ‑Automatic control systems‖, Tenth Edition, McGraw‑Hill Education, 2017
2. David T Westwick, Robert E. Kearney, Identification of Nonlinear Physiological Systems, Wiley‑ IEEE Press, 2003.

E-RESOURCES :

1. https://nptel.ac.in/courses/112107214
2. https://www.youtube.com/watch?v=SFYwTKm6lvg

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19MDPX22   **BIOMECHANICS**   **L T P C**

3 0 0 3

OBJECTIVES

The student should be made to:

- Explain the principles of mechanics.
- Discuss the mechanics of physiological systems.
- Explain the mechanics of joints.
- Illustrate the mathematical models used in the analysis of biomechanical systems
- Concerns the interrelations of the skeleton, muscles, and joints.
- The investigation of the forces that act on limbs

UNIT I: INTRODUCTION TO MECHANICS   9

Introduction — Scalars and vectors, Statics — Force types, Resolution and composition of forces, Moments of force and couple, Resultant force determination, parallel forces in space, equilibrium of coplanar forces, Dynamics, Basic principles – Linear motion, Newton's laws of motion, Impulse and Momentum, Work and Energy Kinetics — Velocity and acceleration, Kinematics — Link segment models, Force transducers, Force plates, Introduction to Constitutive equations — Constitutive equations of Nonviscous fluid, Newtonian Viscous fluid and Hookean Elastic solid.

UNIT II: BIOFLUID MECHANICS   9

Intrinsic fluid properties – Density, Viscosity, Compressibility and Surface Tension, Viscometers – Capillary, Coaxial cylinder and cone and plate, Rheological properties of blood, Pressure-flow relationship for Non-Newtonian Fluids, Fluid mechanics in straight tube — Steady Laminar flow, Turbulent flow, Flow development, Viscous and Turbulent Sheer Stress, Effect of pulsatility, Boundary Layer Separation, Structure of blood vessels, Material properties and modeling of Blood vessels, Heart –Cardiac muscle characterisation, Native heart valves – Mechanical properties and valve dynamics, Prosthetic heart valve fluid dynamics.

UNIT III: BIOSOLID MECHANICS   9

Constitutive equation of viscoelasticity — Maxwell &Voight models, anisotropy, Hard Tissues — Structure, blood circulation, elasticity and strength, viscoelastic properties, functional adaptation, Soft Tissues — Structure, functions, material properties and modeling of Soft Tissues — Cartilage,Tendons and Ligaments Skeletal Muscle – Muscle action, Hill's models, mathematical modeling,Bone fracture mechanics, Implants for bone fractures..

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UNIT IV: BIOMECHANICS OF JOINTS   9

Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, Free body diagrams, Structure of joints, Types of joints, Biomechanical analysis of elbow, shoulder, spinal column, hip, knee and ankle, Lubrication of synovial joints, Gait analysis, Motion analysis using video.

UNIT V: MODELING AND ERGONOMICS   9

Introduction to Finite Element Analysis, finite element analysis of lumbar spine; Ergonomics — Musculoskeletal disorders, Ergonomic principles contributing to good workplace design, Design of a Computer work station, Whole body vibrations, Hand transmitted vibrations

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Understand the principles of mechanics
- Outline the principles of biofluid dynamics.
- Explain the fundamentals of bio-solid mechanics.
- Apply the knowledge of joint mechanics.
- Give Examples of computational mathematical modelling applied in biomechanics.
- Measure for preclinical research of musculoskeletal trauma

TEXT BOOKS

1. Y.C. Fung, ―Bio-Mechanics- Mechanical Properties of Tissuesǁ, Springer-Verlag, 1998.
2. Subrata Pal, ―Textbook of Biomechanicsǁ, Viva Books Private Limited, 2009

REFERENCES

1. Krishna B. Chandran, Ajit P. Yoganathan and Stanley E. Rittgers, ―Biofluid Mechanics: TheHuman Circulationǁ, Taylor and Francis, 2007
2. Sheraz S. Malik and Shahbaz S. Malik, ―Orthopaedic Biomechanics Made Easyǁ, Cambridge University Press, 2015.

E-RESOURCES :

1. https://onlinecourses.nptel.ac.in/noc23_bt04/preview
2. https://www.youtube.com/watch?v=jHz-YjnHKK8&list=PL-S5xYt7a4QxF0HWK8X3G9WxmqEvCYWEF

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19MDPX23   **INTRODUCTION TO CELL BIOLOGY**   **L T P C**

3 0 0 3

OBJECTIVES

The student should be made to:

- Provide knowledge on cell structure.
- Gain knowledge on cell organelle and function.
- Explain the cell division.
- Discuss the cell macromolecules
- Know about enzymes.

UNIT I: CELL STRUCTURE   9

Cell organization, structure of organelles, extra cellular matrix and cell junctions.

UNIT II: CELL ORGANELLE AND FUNCTION   9

Nuclues, Mitochondria, Lysosomes, Endoplasmic reticulum, Golgi apparatus, vesicles, centrosomes, cell membranes, ribosomes, cytosol, chloroplasts, flagella, cell wall.

UNIT III: DIVISION   9

Cell cycle – mitosis, meiosis, cell cycle regulation and apoptosis.

UNIT IV: MACROMOLECULES   9

DNA, RNA and Proteins – basic units, architectural hierarchy and organisation, functions.

UNIT V: ENZYMES   9

Enzymes – Structure, Mechanism of action, Factors that affect enzyme activity, Common enzymes used in industrial setup of plant and animal origin

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Understand the principles of cell structure.
- Outline the principles of cell organelle and function.
- Explain the fundamentals of cell cycle.
- Apply the knowledge of macromolecules.
- Give Examples of Factors that affect enzyme activity.

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TEXT BOOKS

1. Lodish, Harvey etal., "Molecular Cell Biology", 5 th Edition, W.H.Freeman, 2005.

2. Cooper, G.M. and R.E. Hansman "The Cell : A Molecular Approach", 4 th Edition, ASM Press, 2007

REFERENCES

1. McDonald, F etal., " Molecular Biology of Cancer" 2nd Edition, Taylor & Francis, 2004

2. King, Roger J.B. "Cancer Biology" Addison Wesley Longman, 1996.

E-RESOURCES :

1. https://onlinecourses.nptel.ac.in/noc22_bt33/preview

2. https://www.youtube.com/watch?v=3QHA698oMXw&list=PLyqSpQzTE6M93irerMnIZWfAsx5kU9yRl

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19MDPX24   **WEARABLE TECHNOLOGY**   **L T P C**

3 0 0 3

OBJECTIVES

The student should be made to:

- Introduce the basic principles of Wearable Monitoring Systems along with Smart Sensors,
- Understand the wearable devices for healthcare and vital parameters.
- Know the principles of different sensors for communication.
- Explain the functions of wireless body area networks.
- Know the different algorithms for wearable technology.

UNIT I: INTRODUCTION TO WEARABLES   9

Wearable Systems- Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Types of Wearable Systems, Components of Wearable Systems, Physiological Parameters Commonly Monitored in Wearable Applications, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles, Sport Application, Smart Fabrics: Intelligent Textiles.

UNIT II: WEARABLE DEVICES FOR HEALTHCARE AND VITAL PARAMETERS   9

Vital Parameters Monitored and their Significances, Bio-potential Signal Recordings (ECG, EEG, EMG), Dry Electrodes Design and Fabrication methods, Cuff-less Blood Pressure Measurement, PPG, Galvanic Skin Response (GSR), Body Temperature Measurements, Activity Monitoring for Energy Expenditure, Respiratory parameters, Wearable sensors for Body Temperature: Intermittent and Continuous temperature monitoring, Detection principles – thermistor, infrared radiation, thermopile.

UNIT III: COMMUNICATION TECHNOLOGIES   9

Principles of different sensors, Micro-Motors and Communication Channels - Accelerometers, Optical sensor, GPS- Various Input Methods, Power Requirements, Wearable Systems Packaging, Batteries and Charging, Wireless Communication Technologies and Protocols, Receiver Systems.

UNIT IV: WIRELESS BODY AREA NETWORKS   9

Wireless Body Area Networks – Introduction, Personal Area Networks (PAN), Application in Vital Physiological Parameter monitoring, Design of Sensor & Sink Nodes, Architecture, Communication & Routing Protocols, Security, Power and Energy Harvesting, Mobile Applications Based Devices.

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UNIT V: DATA PROCESSING AND VALIDATION   9

Classification Algorithms, Data Mining and Data Fusion, Signal Processing Algorithms in Wearable Applications, Issues of Wearable Physiological Monitoring Systems, Statistical Validation of Parameters, Certifications of Medical Devices and Patenting

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Explain the basic principles of Wearable Monitoring Systems along with Smart Sensors,
- Analyze the wearable devices for healthcare and vital parameters.
- Use the different sensors for communication technology.
- Understand the functions of wireless body area networks.
- Implement the different algorithms for wearable technology

TEXT BOOKS

1. Edward Sazonov, Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elseiver, 2014.
2. Annalisa Bonfiglo, Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011

REFERENCES

1. Gieras, The proliferation of patient-worn wireless telemetry technologies within the U.S. Healthcare environment. Proc. 4th IEEE Conf. on Information Technology Applications in Biomedicine, 2003: 295–298
2. Wearable and Autonomous Biomedical Devices and Systems for Smart Environment", by Aimé Lay-Ekuakille and Subhas Chandra Mukhopadhyay, Springer 2010.

E-RESOURCES :

1. https://www.youtube.com/watch?v=gp_X_DwoyC4 (Introduction to Wireless systems)
2. https://www.coursera.org/lecture/intellectual-property-healthcare-industry/module-4-introduction-and-ip-review-IxCep (introduction and IP Review)

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19MDPX25	COMPUTER VISION	L T P C
		3 0 0 3

OBJECTIVES

The student should be made to:

- Understand the fundamental concepts related to multi-dimensional signal and image processing feature extraction,
- Pattern analysis visual geometric modeling and stochastic optimization.
- Realize about different models for detection and recognition for developing algorithms.
- Explain the 3D vision and motion of computer vision.
- Known the applications of computer vision.
- To enable computing devices to correctly identify an object or person in a digital image and take appropriate action.

UNIT I: IMAGE PROCESSING FOUNDATIONS   **9**

Review of image processing techniques – classical filtering operations –Image Restoration-Blur Identification- Super resolution method. Image Segmentation- Watershed method, k-means clustering method–Topological Derivative based segmentation.

UNIT II: SHAPES AND REGIONS   **9**

Binary shape analysis – connectedness – object labeling and counting – size filtering – distancefunctions skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shapemodelsandshaperecognition–centroidalprofiles–handlingocclusion–boundarylengthmeasures boundary descriptors – chain codes – Fourier descriptors – region descriptors –moments.

UNIT III: HOUGH TRANSFORM   **9**

Line detection – Hough Transform (HT) for line detection – foot-of-normal method – line localization – line fitting – RANSAC for straight line detection – HT based circular object detection – accurate center location – speed problem– ellipse detection – Case study: Human Iris location.

UNIT IV: 3D VISION AND MOTION   **9**

Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline-based motion.

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UNIT V: APPLICATIONS   9

Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking and occlusion–combine views from multiple cameras–human gait analysis- Application- In-vehicle vision system

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Implement fundamental image processing techniques required for edge and point detection.
- Compute shapes, contours and boundary features from the detected image and represent the regions using chain codesand fourier descriptors.
- Apply Hough Transform to detect lines, circles and ellipses for human iris images.
- Contrast the shape from texture, focussing and shading and apply reconstruction techniques to the image.
- Develop algorithms for face detction, recognition and human gait analysis.
- Computer vision in AI is the development of automated systems to interpret images in the same manner as people do

TEXT BOOKS

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer Science & Business Media, 2010.
2. Rajalingappaa Shanmugamani, "Deep Learning for Computer Vision", Springer Science & Packt Publishing Ltd, 2018

REFERENCES

1. Simon J. D. Prince, "Computer Vision: Models, Learning, and Inference", Cambridge University Press, 1st Edition, 2012
2. Jason Brownlee, "Deep Learning for Computer Vision: Image Classification, Object Detection, and Face Recognition in Python", Edition: v1.7, Machine Learning Mastery, 2019.

E-RESOURCES :

1. NPTEL Videos https://www.youtube.com/watch?v=7xKhYfPel9w, "Image Segmentation"

2. NPTEL Videos http://www.digimat.in/nptel/courses/video/117105135/L57.html, "Hough Transform"

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OPEN ELECTIVE-I

19MDOX01   **HOSPITAL MANAGEMENT**   **L T P C**

3 0 0 3

OBJECTIVES

The student should be made to:

- Understand the fundamentals of hospital administration and management.
- Know the market related research process
- Explore various information management systems and relative supportive services.
- Learn the quality and safety aspects in hospital.
- Study the Patient safety is fundamental to delivering quality essential health services.
- Design a system for better patient care

UNIT I: OVERVIEW OF HOSPITAL ADMINISTRATION   9

Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning- Equipment Planning – Functional Planning - Current Issues in Hospital Management –Telemedicine - Bio-Medical Waste Management..

UNIT II: HUMAN RESOURCE MANAGEMENT IN HOSPITAL   9

Principles of HRM — Functions of HRM — Profile of HRD Manager — Tools of HRD – Human Resource Inventory – Manpower Planning. Different Departments of Hospital, Recruitment, Selection, Training Guidelines –Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer, Communication – nature, scope, barriers, styles and modes of communication.

UNIT III: MARKETING RESEARCH PROCESS   9

Marketing information systems - assessing information needs, developing & disseminating information - Market Research process - Other market research considerations — Consumer Markets & Consumer Buyer Behaviour - Model of consumer behaviour - The buyer decision process - Model of business buyer behavior — Major types of buying situations - WTO and its implications.

UNIT IV: HOSPITAL INFORMATION SYSTEMS & SUPPORTIVE SERVICES   9

Management Decisions and Related Information Requirement - Clinical Information Systems - Administrative Information Systems - Support Service Technical Information Systems — Medical Transcription, Medical Records Department – Central Sterilization and Supply Department– Pharmacy– Food Services - Laundry Services.

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UNIT V: QUALITY AND SAFETY ASPECTS IN HOSPITAL   **9**

Quality system – Elements, implementation of quality system, Documentation, Quality auditing, International Standards ISO 9000 – 9004 – Features of ISO 9001 – ISO 14000 – Environment Management Systems. NABA, JCI, NABL. Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules. Health Insurance & Managing Health Care – Medical Audit – Hazard and Safety in a hospital Setup.

                                          TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Explain the principles of Hospital administration.
- Identify the importance of Human resource management.
- List various marketing research techniques.
- Identify Information management systems and its uses.
- Understand safety procedures followed in hospitals.
- design a system for better patient care

TEXT BOOKS

1. Gupta Joydeep Das, "Hospital Administration And Management: A Comprehensive Guide", – Second Edition, 2015.

2. Subrahmanyam B.V., "Hospital Management Ad Administration Principles And Practice Including Law"– 2018

REFERENCES

1. Peter Berman —Health Sector Reform in Developing Countries‖ - Harvard University Press,1995.

2. Arnold D. Kalcizony & Stephen M. Shortell, —Health Care Management‖, 6th Edition CengageLearning, 2011.

E-RESOURCES :

1. https://onlinecourses.nptel.ac.in/noc20_mg69/preview

2. https://www.youtube.com/watch?v=Ax76hjdilpg

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19MDOX02   PRINCIPLES OF RADIODIAGNOSIS & RADIOTHERAPY   L T P C

3 0 0 3

OBJECTIVES

The student should be made to:

- Understand the generation of X-rays occurs when electrons are accelerated under a potential difference and turned into electromagnetic radiation.
- Analyze Image processing to convert the raw digital image to an optimal or usable radiographic image.
- Guide treatments such as implants or injections, or in orthopedic surgery
- See if there's a restriction in blood flow going to the heart
- Obtain an optimal balance between delivering a high dose to target volume and a low dose to intervening tissues.
- Help in imaging procedures in other imaging processes as well

UNIT I: PRODUCTION OF X RAYS   9

Production of X ray -Various components of radiographic systems, Functional Block Diagram Electrical circuit for X-ray unit – Filament circuit and Ma control - HT circuit & KV control- x ray penetration based on wave lengths.

UNIT II: RADIOGRAPHIC SYSTEMS   9

X-ray tubes - fixed anode, rotating anode, x-ray tubes for specialized applications - mammography, CT -Rating charts of Exposure switching - Primary & secondary – Comparison. Control of exposure time – Types of timer, circuit design of a simple timer circuit. Scattered radiation control in radiography – collimators –grids – types , material used and characteristics, bucky grids Radiations units.

UNIT III: FLUOROSCOPY SYSTEMS   9

Various components of fluoroscopic system - Image intensifier -parts & working.TV chain for fluoroscopy- optical coupling, Types of TV camera & monitors. Automatic brightness control system.

UNIT IV: ANGIOGRAPHIC TECHNIQUES IN RADIOLOGY   9

Angiographic techniques in radiology – Conventionalangiography, basic principle. DSA-Principle and clinical applications Selective and Super-selective angiography (basic concept only).Coronary angiographic techniques –conventional, CT coronaryangiography, ECG gating (basic concept only).

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UNIT V: RADIOTHERAPY   **9**

Measurement of output and use of ISODOSE charts - Radiation therapy planning.Collimators and beam direction devices. Clinical applications of radio therapy.Principles of linear accelerators for radiation therapy. eletherapy sources - Dosage data for clinical applications – kV& MV radiations – Commonly used radiation sources (radionuclides) for brachytherapy.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Interpret the construction and production of X-rays in imaging systems
- Demonstrate the knowledge of concepts & principles associated with the operation of CT imaging equipment
- Differentiate relaxation process and NMR pulse sequences in magnetic resonance imaging
- Suggest an appropriate nuclear medicine systems and technique for a diagnosis environment
- Identify the need for radiation protection and various monitoring techniques used for self, staff, and patients
- Explain the principles of Angiographic techniques in radiology

TEXT BOOKS

1. S. Christofides D.R. Dance, A.D.A. Maidment, I.D. McLean, K.H. Ng "Diagnostic Radiology Physics: A Handbook for Teachers and Students", International atomic energy agency Vienna, 2014.
2. W. J. Meredith, J. B. Massey "Fundamental Physics of Radiology" 2013

REFERENCES

1. James C. Carr, Timothy J. Carroll "Magnetic Resonance Angiography Principles and Applications" 2011.
2. Rolf Behling,"Modern Diagnostic X-Ray Sources Technology", Manufacturing, Reliability · 2021.

E-RESOURCES :

1. https://www.ncbi.nlm.nih.gov/books/NBK537046/

2. https://www.slideshare.net/prasadvagal/diagnostic-radiology-3266093

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19MDOX03	MEDICAL ROBOTICS	L T P C
		3 0 0 3

OBJECTIVES

The student should be made to:

- Understand the basics of Robotics, Kinematics.

- Understand the basics of Inverse Kinematics

- Explore various kinematic motion planning solutions for various Robotic configurations & applications of Robots in Medicine.

- Know the process of breaking down a desired movement task into discrete motions that satisfy movement constraints.

- study the status of the. assessment of robot-assisted surgery.

- Enable a high level of patient care, efficient processes in clinical settings

UNIT I: INTRODUCTION   9

Introduction Automation and Robots, Classification, Application, Specification, Notations, Direct Kinematics Dot and cross products, Coordinate frames, Rotations, Homogeneous coordinates Link Coordination arm equation – Five-axis robot, Four-axis robot, Six-axis robot..

UNIT II: KINEMATICS   9

Inverse Kinematics – General properties of solutions tool configuration, Five axis robots, Three Four axis, Six axis Robot, Workspace analysis and trajectory planning work envelope and examples, workspace fixtures, Pick and place operations, Continuous path motion, Interpolated motion, Straight-line motion.

UNIT III: ROBOT VISION   9

Robot Vision Image representation, Template matching, Polyhedral objects, Shane analysis, Segmentation – Thresholding, region labeling, Shrink operators, Swell operators, Euler numbers, Perspective transformation, Structured illumination, Camera calibration.

UNIT IV: PLANNING   9

Task Planning Task level programming, Uncertainty, Configuration, Space, Gross motion, Planning, Grasp Planning, Fine-motion planning, Simulation of planar motion, Source and Goal scenes, Task Planner simulation.

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UNIT V: CASE STUDIES   **9**

Biomedical Image Analysis on Wireless Capsule Endoscopy Images and Videos, Cooperative Control Design in Drug Delivery, Cancer Targeted Therapy, Catheter Surgery System.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Describe the basics of robotic systems.
- Apply the knowledge in formulating Kinematics
- Implement the Robotic Vision in robotic systems.
- Construct Inverse Kinematic motion planning solutions for various Robotic Configurations
- Outline the Robotic systems for Medical application.
- enable a high level of patient care

TEXT BOOKS

1. Achim Schweikard, Floris Ernst – "Medical Robotics" – 2015.

2. Paula Gomes - "Medical Robotics – Minimally Invasive Surgery" – 2012

REFERENCES

1. Craig, "Introduction to Robotics Mechanics and Control", Pearson Education, 2nd Edition, 2004..

2. Mittal.R.K and Nagrath.I.J "Robotics and Control", McGraw Hill, 2003.

E-RESOURCES :

1. https://onlinecourses.nptel.ac.in/noc18_me61/preview
2. https://nptel.ac.in/courses/112105249

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19MDOX04	HOSPITAL CONSTRUCTION PLANNING AND	L T P C
	ORGANIZATION BEHAVIOR	3 0 0 3

OBJECTIVES

The student should be made to:

- Understand the necessity of architecture and planning in Hospitals.
- Understand and appreciate the human behavior in organizations
- Gain knowledge on technical analysis of hospital organization.
- Get familiarized with the designing and maintenance of hospital systems.
- Learn the quality and safety aspects in hospital.
- Familiarize with the concepts of Facilities planning.

UNIT I: CONSTRUCTION PLANNING   9

Principles of planning – regionalization - hospital planning team – planning process – size of the hospital – site selection – hospital architect – architect report – equipping a hospital – interiors & graphics – construction & commissioning – planning for preventing injuries – electrical safety.

UNIT II: ORGANIZATION BEHAVIOR   9

Organisation Structure and Design - Formal and Informal Organisation - Organisational Climate and Culture - Organisational Change and Development. Organisational Creativity and Innovation.

UNIT III: TECHNICAL ANALYSIS   9

Assessment of the demand and need for hospital services – factors influencing hospital utilization – Purchase planning - bed planning – land requirements – project cost – space requirements –hospital drawings & documents-preparing project report. Impact of Technology on Organisational design. The Electronic health record.

UNIT IV: HOSPITAL STANDARDS AND DESIGN   9

Entrance & Ambulatory Zone – Diagnostic Zone – Intermediate Zone – Critical zone – Service Zone – Administrative zone – List of Utilities – Communication facility – Biomedical equipment - Voluntary & Mandatory standards – General standards – Mechanical standards – Electrical standards – standard for centralized medical gas system – standards for biomedical waste.

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UNIT V: FACILITIES PLANNING   **9**

Transport – Communication – Food services – Mortuary – Information system – Minor facilities –Park facilities. Medical gas pipeline. Biomedical engineering departments in modern hospitals. Laundry services – House keeping services – CSSD-Energy conservation methods – AMC. Ambulance services – Mortuary services – Hospital security services. Disaster management – Fire hazards – Engineering Hazards – Radiological hazards- Outsourcing of Support services – Waste disposal and management - few case studies.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Execute the planning of hospital construction
- Understand and appreciate the human behavior in organizations.
- Do technical analysis of hospital organization.
- Take care design and maintenance of hospital systems.
- Implement the quality and safety aspects in hospital.
- Provide the facilities required for a complete patient care.

TEXT BOOKS

1. Laurie Mullins, Management and Organizational Behavior, Pearson, NewDelhi,2007
2. Gupta S.K, Sunilkant Chandra Shekhar, R Satpathy "Modern Trends in Planning and Designing of Hospitals

REFERENCES

1. Syed Amin Tabish, Hospital and Nursing Homes Planning, Organizations & Management.
2. G.D.Kunders, Hospitals, Facilities Planning and Management.

E-RESOURCES :

1. https://www.youtube.com/watch?v=xktQQjKeSP8
2. https://www.youtube.com/watch?v=RWEtx-Bu85U

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19MDOX05 **IoT IN HEALTHCARE** **L T P C**

3 0 0 3

OBJECTIVES

The student should be made to:

- Understand the fundamentals of IoT.
- Know the basic protocols in wireless sensor network
- Explore various challenges in IoT.
- Learn the IoT applications in Health Industry.
- Study the health care applications through IoT tools.
- Design a IoT application system for better patient care

UNIT I: IoT & M2M **9**

Defining IoT - Characteristics of IoT - Physical design of IoT - Logical design of IoT – Functional blocks of IoT - Communication models & APIs - Machine to Machine - Difference between IoT andM2M - Software define network.

UNIT II: NETWORK & COMMUNICATION ASPECTS **9**

Wireless medium access issues - MAC protocol survey - Survey routing protocols – Sensor deployment & Node discovery - Data aggregation & dissemination.

UNIT III: CHALLENGES IN IoT **9**

Design challenges - Development challenges - Security challenges – Health care challenges.

UNIT IV: DOMAIN SPECIFIC APPLICATIONS OF IoT **9**

Home automation - Industry applications - Surveillance applications - Other IoT applications in health care.

UNIT V: DEVELOPING IoT APPLICATIONS IN HEALTHCARE **9**

Introduction to Python - Introduction to different IoT tools - Developing applications through IoT tools, - Developing sensor based application through embedded system platform - Implementing IoTconcepts with python.

TOTAL: 45 PERIODS

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OUTCOMES

Upon completion of the course, the students will be able to:

- Discuss the concepts of Internet of Things.

- Interpret basic protocols in wireless sensor network.

- Illustrate the need and challenges of IoT.

- Relate IoT applications in Industry domain and analyze their performance.

- Compute the health care applications through IoT tools and Embedded systems.

- Enable healthcare professionals to be more watchful and connect with the patients proactively

TEXT BOOKS

1. Valentina E. Balas, Le Hoang Son, "Internet of Things in Biomedical Engineering", Academic Press,1 st Edition, 2019.

2. Chintan Bhatt, Nilanjan Dey, "Internet of Things and Big Data Technologies for Next Generation Healthcare", SpringerTechnology & Engineering, 2017.

REFERENCES

1. Nilanjan Dey, Amira S. Ashour, "Wearable and Implantable Medical Devices: Applications and Challenges", Academic Press,1 st Edition, 2019.

2. Singh, Rajesh, Gehlot, Anita, Jain, Vishal, Malik, Handbook of Research on the Internet of Things Applications in Robotics and Automation, IGI Global,1 st Edition, 2019.

E-RESOURCES :

1. NPTEL Videos https://nptel.ac.in/courses/106/105/106105166/ "Introduction to IoT",Prof.Sudip Misra, IIT Kharagpur
2. NPTEL Videos https://freevideolectures.com/course/4638/nptel-introduction-internet-things/58 " Case Study: Healthcare" Prof.Sudip Misra, IIT Kharagpur

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OPEN ELECTIVE - II

19MDOX06   **MEDICAL INFORMATICS**   **L T P C**

3 0 0 3

OBJECTIVES

The student should be made to:

- Learn and adapt ICT applications in health informatics
- Study the modern healthcare data standards
- Understand the use of latest technology to share medical records
- Create health care insights develop new approaches
- Learn recent trends in medical informatics.
- Develop a safe, evidence/outcomes based approach to patient evaluation

UNIT I: INTRODUCTION TO MEDICAL INFORMATICS   9

Introduction - Medical Informatics — Structure of Medical Informatics- Computer based medical information retrieval, Functional capabilities of a computerized Hospital Information System, Health Informatics – Medical Informatics, Bioinformatics, Clinical informatics, Nursing informatics, Public health informatics.

UNIT II: MEDICAL DATA STORAGE AND AUTOMATION   9

Representation of health Data, Relational, Hierarchical and network Approach, Data modeling for patient database development. Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computer assisted medical imaging, Radiation therapy and planning, Nuclear Magnetic Resonance.

UNIT III: MEDICAL STANDARDS AND COMPUTERISED PATIENT RECORD   9

Evolution of Medical Standards — IEEE 11073 - HL7 — DICOM — IRMA - LOINC — HIPPA. Computer based Patient Records-History taking by computer, Dialogue with the computer, Components and functionality of CPR, Development tools, CPR in Radiology, Clinical information system, Computerized prescriptions for patients.

UNIT IV: HEALTH INFORMATICS   9

Bioinformatics Databases, Bio-information technologies, Genome Analysis, Semantic web and Bioinformatics, Genome projects. Clinical information system, data for decision making, Medical diagnostic and decision support systems, Decision analysis in health informatics.

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UNIT V: RECENT TRENDS IN MEDICAL INFORMATICS **9**

Virtual reality applications in medicine, Computer assisted surgical techniques-Virtual endoscopy, Computer assisted surgery, Surgical simulation. Computer assisted medical education, Computer assisted patient education and health, Telemedicine, virtual Hospitals - Smart Medical Homes – Personalized e-health services.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Discuss the structure of medical Informatics and functional capabilities of Hospital Information System.
- Describe the need of computers in medical imaging and automation in clinical laboratory.
- Analyze medical standards
- Identify recent trends and different ICT applications in medical Informatics.
- learn recent trends in medical informatics
- Understand the various aspects of informatics applied in health industry so that quality of health care is improved

TEXT BOOKS

1. Mohan Bansal, ―Medical informatics‖, Tata McGraw Hill Publishing Ltd, 2003.
2. R.D.Lele, ―Computers in medicine progress in medical informatics‖, Tata Mcgraw Hill, 2005

REFERENCES

1. Alain Venot, Anita Burgun, Catherine Quantin, ―Medical Informatics, e-Health: Fundamentalsand Applications‖, Springer Science & Business Media, 2013.
2. Edward H. Shortliffe, James J. Cimino, ―Biomedical Informatics: Computer Applications inHealth Care and Biomedicine‖, Springer Science & Business Media, 2013.

E-RESOURCES :

1. https://nptel.ac.in/courses/110104095
2. https://www.slideshare.net/moniefeied/ehealth-5196362

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19MDOX07   **BIOMEDICAL INSTRUMENTATION**   **L T P C**

3 0 0 3

OBJECTIVES

The student should be made to:

- Gain knowledge on basic concepts of medical instrumentation.
- Know about biopotential electrodes and amplifiers
- Know the basic measurements of physiological parameters
- Know about medical equipment design and developments.
- Develop an understanding of the nonelectrical parameters measurements so as to enable• to record various non electrical parameters.
- Learn the methods used for blood flow measurement parameters.

UNIT I: BASIC CONCEPTS OF MEDICAL INSTRUMENTATION AND BIO SENSORS   9

Terminology of medicine and medical devices, generalized medical instrumentation system, alternative operational modes, medical measurement constraints-classification of biomedical instruments-biostatistics-regulations of medical devices. Origin of bio potential and its propagation. Electrode–skin interface, half cell potential. Types of electrodes and its application. Recording problems - measurement with two electrodes. Need of sensors, working principle of biosensor, various types of biosensors and itsapplications, bio transducers, bio interface.

UNIT II: ELECTRODE CONFIGURATIONS & BIO AMPLIFIER   9

Biosignals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier, isolation amplifiers — transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier.

UNIT III: MEASUREMENTS OF BLOOD PRESSURE, BLOOD VOLUME AND CARDIAC OUTPUT   9

Direct and indirect measurements-harmonic analysis of blood pressure waveforms-heart sounds-phonocardiography - Electromagnetic flow meters- ultrasonic flowmeters-chamber plethysmography-photo plethysmography. Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement

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UNIT IV: CLINICAL LABORATORY INTRUMENTS   **9**

Blood gas and acid base Physiology –Electro chemical sensor chromatology-electrophoresis - Blood cell counter, Auto analyser,Centrifuge, Blood gas analyzers, colorimeter, flame photometer, spectrophotometer.

UNIT V: DESIGN AND DEVELOPMENT OF BIOMEDICAL DEVICES AND SYSTEMS   9

The Essentials of Design—Overview- Biomedical Engineering Design in Industrial Context- Fundamental Design Tools- Product Definition- Product Development- Hardware Development Methods and Tools- Software Development Methods and Tools- Biomaterials and Material Testing- Biological Engineering Designs. Emerging Issues in Healthcare- Innovation and Rights- Industrial Designs- Patent Classification- Examples of Industrial Design Requirements Evaluations.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Perform Electrical and non-electrical physiological measurements
- Explain the function of bio amplifiers.
- Explain the functions of laboratory and radiological equipments
- Explain about medical equipment designing procedure
- Analyze different biopotential characteristics and recording methods.
- Develop measurement systems for non electrical parameters measurements.

TEXT BOOKS

1. Medical Instrumentation: Application and Design- by John G. Webster-john wiley & sons-inc,2009-fourth edition.
2. Design of Biomedical Devices and Systems, Third Edition- Paul H. King, Richard C. Fries,Arthur T. Johnson- CRC Press-2014

REFERENCES

1. Developing Biomedical Devices-Design, Innovation and Protection.by Andreoni, Giuseppe,Barbieri, Massimo, Colombo, Barbara-poliMi springer briefs-2014.
2. Medical Instruments and Devices: Principles and Practices by Steven Schreiner, Joseph D.Bronzino, Donald R. Peterson- CRC Press –first edition -2017.

E-RESOURCES :

1. https://nptel.ac.in/courses/108105101
2. https://onlinecourses.nptel.ac.in/noc22_bt56/preview

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19MDOX08　　　　　**HOSPITAL WASTE MANAGEMENT**　　　　　**L T P C**

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　3 0 0 3

OBJECTIVES

The student should be made to:

- Understand the hazardous materials used in hospital and its impact on health
- Understand various waste disposal procedures and management.
- Avoid environmental pollution and adverse health effects
- Create an overall awareness to offer guidelines for safe work practices
- Control infectio and diseases
- Analyze and decide the treatment and disposal scheme of wastes.

UNIT I: HEALTHCARE HAZARD CONTROL AND UNDERSTANDING ACCIDENTS　　9

Healthcare Hazard Control : Introduction, Hazard Control, Hazard Control Management, Hazard Control Responsibilities, Addressing Behaviors, Hazard Control Practice, Understanding Hazards, Hazard Analysis, Hazard Control and Correction, Personal Protective Equipment, Hazard Control Committees, Hazard Control Evaluation, Hazards, System Safety, Ergonomics. Understanding Accidents: Accident Causation Theories, Human Factors, Accident Deviation Models, Accident Reporting, Accident Investigations, Accident Analysis, Organizational Functions That Support Accident Prevention, Workers' Compensation, Orientation, Education, and Training.

UNIT II: BIOMEDICAL WASTE MANAGEMENT　　　　　　　　　　　9

Biomedical Waste Management : Types of wastes, major and minor sources of biomedical waste, Categories and classification of biomedical waste, hazard of biomedical waste, need for disposal of biomedical waste, waste minimization, waste segregation and labeling, waste handling, collection, storage and transportation, treatment and disposal.

UNIT III: HAZARDOUS MATERIALS　　　　　　　　　　　　　9

Hazardous Materials : Hazardous Substance Safety, OSHA Hazard Communication Standard, DOT Hazardous Material Regulations, Healthcare Hazardous Materials, Medical Gas Systems, Hazardous Waste Operations and Emergency Response Standard, Respiratory Protection

UNIT IV: FACILITY SAFETY　　　　　　　　　　　　　　　9

Facility Safety : Introduction, Facility Guidelines Institute, Administrative Area Safety, Slip, Trip, and Fall Prevention, Safety Signs, Colors, and Marking Requirements, Scaffolding, Fall Protection,Tool Safety, Machine Guarding, Compressed Air Safety, Electrical Safety, Control of Hazardous Energy, Permit Confined Spaces, OSHA Hearing Conservation Standard, Heating,

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Ventilating, and Air-Conditioning Systems, Assessing IAQ, Landscape and Grounds Maintenance, Fleet and Vehicle Safety.

UNIT V: INFECTION CONTROL, PREVENTION AND PATIENT SAFETY   9

Healthcare Immunizations, Centers for Disease Control and Prevention, Disinfectants, Sterilants, and Antiseptics, OSHA Bloodborne Pathogens Standard, Tuberculosis, Healthcare Opportunistic Infections, Medical Waste. Patient Safety: An Organizational Function, Errors and Adverse Events, Safety Cultures, Patient-Centered Healthcare, Quality Improvement Tools and Strategies, Healthcare-Associated Infections, Medication Safety.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Analyze various hazards, accidents and its control
- Design waste disposal procedures for different biowastes
- Categorise different biowastes based on its properties
- Design different safety facility in hospitals
- Propose various regulations and safety norms
- Analyze different treatment and disposal scheme of wastes.

TEXT BOOKS

1. Tweedy, James T., Healthcare hazard control and safety management-CRC Press_Taylor andFrancis (2014).
2. Anantpreet Singh, Sukhjit Kaur, Biomedical Waste Disposal, Jaypee Brothers Medical Publishers (P) Ltd (2012)

REFERENCES

1. R.C.Goyal, ―Hospital Administration and Human Resource Management‖, PHI – Fourth Edition,2006.
2. V.J. Landrum, ―Medical Waste Management and disposal‖, Elsevier, 1991.

E-RESOURCES :

1. https://nptel.ac.in/courses/105106056
2. https://nptel.ac.in/courses/105105160

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19MDOX09	MEDICAL EQUIPMENT DESIGN	L T P C
		3 0 0 3

OBJECTIVES

The student should be made to:

- Explore the concepts in designing power systems for medical electronics

- Understand the essential circuitry needed for sensor design.

- Develop an understanding of data acquisition system design

- Provide knowledge about noise cancellation system

- Gain necessary knowledge about the hardware implementation of DSP

- Design a innovative medical equipments for the current needs..

UNIT I: DESIGN OF POWER SUBSYSTEMS IN MEDICAL ELECTRONICS   9

Transient voltage protections- Electromagnetic interference- Inrush current control Overvoltage protection- Under voltage protection- Overload protection- Output filtering- Power failure warning- Flightback switch back power supplies- Half-bridge Flyback converter

UNIT II: SENSOR DESIGN FUNDAMENTALS   9

Sensor parameters- Sensor Interfacing- Signal conditioning amplifiers- Instrumentation amplifiers- Isolation amplifiers- Charge-coupled device sensors- Position and motion sensors Accelerometers- Temperature sensors- Fiber optics based medical sensors

UNIT III: DATA ACQUISITION SYSTEMS   9

Sample and hold conversion- Multichannel acquisition- High speed sampling in ADC- Selection of drive amplifier for ADC performance- Driving ADCs with switched capacitor inputs- ADC input protection- External protection of amplifiers- High speed ADC architectures

UNIT IV: NOISE AND INTERFERENCE ISSUES IN ANALOG CIRCUITS   9

Noise calculations in Op-Amp- Internal noise in Op-Amps- Proper power supply decoupling Bypass capacitors and resonances- Designing power bus rails in power-ground planes for noise control- ASIC .

UNIT V: HARDWARE APPROACH TO DIGITAL SIGNAL PROCESSING   9

DSP hardware- Arithmetic logic unit- Multiplier-accumulator- Shifter- Data address generators Program sequencer- Serial ports- Interfacing ADCs and DACs to digital signal processors Parallel ADCs o DSP interface- Parallel DAC to DSP interface- Serial interfacing to DSP processors.

.**TOTAL: 45 PERIODS**

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OUTCOMES

Upon completion of the course, the students will be able to:

- Understand the power systems used in the design of medical electronics devices
- Classify the biosensors design according the type of device
- Interpret the data acquired from the sensors.
- Enumerate the noise and interference issues in the devices
- Understand the signal processing of the medical electronic device.

TEXT BOOKS

1. Peter J.Ogrodnik, "Medical Device Design: Innovation from Concept to Market" 2nd Edition, Kindle Edition Academic Press; 2nd edition (30 October 2019).

2. Reinaldo Perez "Design of Medical Electronic Devices Hardcover – 21" March 2002 Academic Press; 1st edition (21 March 2002).

REFERENCES

1. Kunal Pal, Heinz-Bernhard Kraatz, Anwesha Khasnobish, Bioelectronic and medical devices, Elsevier, 2019

2. Rüdiger Kramme, Klaus-Peter Hoffmann, Robert Steven Pozos, Springer handbook of medical technology, Springer, 2011.

E-RESOURCES

1. https://www.youtube.com/watch?v=aBeRFdAA2og (Sensor Design Fundamentals)
2. https://www.youtube.com/watch?v=WwQSfk6SSSo (Data Acquisition Systems)

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19MDOX10   **MEDICAL IMAGING TECHNIQUES**   **L T P C**

3 0 0 3

OBJECTIVES

The student should be made to:

- Gain sound knowledge about Radiography ,CT, Fluoroscopy and Image quality
- Understand the concepts of Neuro Magnetic Imaging and MRI.
- Examine your organs, tissues and skeletal system.
- Detect explosives, and in voltage regulators and current surge protectors
- Create pictures of structures inside the body using sound waves
- Know the causes of an injury or illness and ensure that the diagnosis is accurate.

UNIT I: RADIOGRAPHY AND FLUOROSCOPY   9

Nature of X-rays- X-Ray absorption — Tissue contrast. X- Ray Equipment — X-Ray Tube, the collimator, Bucky Grid, Digital Radiography- discrete digital detectors, storage phosphor and film scanning, — Fluoroscopy — X-ray Image Intensifier -Digital Fluoroscopy. Angiography, cine Angiography. Digital subtraction Angiography. Mammography

UNIT II: COMPUTED TOMOGRAPHY   9

Principles of sectional imaging, Principles of computed Tomographic Imaging - Scan motions, X-ray sources. Influences of Images quality: Unsharpness- contrast - Image Noise-2-D image reconstruction techniques-Back projection and iterative

UNIT III: **MAGNETIC RESONANCE IMAGING AND SPECTROSCOPY   9**

Fundamentals of magnetic resonance- overview - Relaxation processes T1 and T2. Block Diagram approach of MRI system- system Magnet (Permanent, Electromagnet and Super conductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, contrast agents- tissue contrast in MRI- MRangiography, MR spectroscopy, fMRI

UNIT IV: **RADIO ISOTOPIC IMAGING AND INFRARED IMAGING   9**

Radio nuclides for imaging -Rectilinear scanners – linear scanners – Gamma camera - Emission computed tomography- SPECT, PET- Physics of thermography – imaging systems – pyroelectric vidicon camera clinical, thermography – liquid crystal thermography .

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UNIT V: ULTRASOUND, NEUROMAGNETIC IMAGING   **9**

Ultrasound: Wave propagation and interaction in Biological tissues -Transducers and imaging systems- Imaging modes- Time required to obtain Images- System components, signal processing -dynamic Range- Ultrasound Image Artifacts- Quality control, Origin of Doppler shift- Limitations of Doppler systems. Neuromagnetic Imaging: Background.

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TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, the students will be able to:

- Study about various medical image acquisition methods.
- Understand the concept of computed tomographic imaging
- Gain sound knowledge about CT, Fluoroscopy and Image quality
- Understand the concepts of Neuro Magnetic Imaging and MRI.
- Analyze the principle and operation modes of Ultrasound Imaging
- Understand the signal processing of the medical electronic device.

TEXT BOOKS

1. Peter J.Ogrodnik, "Medical Device Design: Innovation from Concept to Market" 2nd Edition, Kindle Edition Academic Press; 2nd edition (30 October 2019).

2. Reinaldo Perez "Design of Medical Electronic Devices Hardcover – 21" March 2002 Academic Press; 1st edition (21 March 2002).

REFERENCES

1. Kunal Pal, Heinz-Bernhard Kraatz, Anwesha Khasnobish, Bioelectronic and medical devices, Elsevier, 2019

2. Rüdiger Kramme, Klaus-Peter Hoffmann, Robert Steven Pozos, Springer handbook of medical technology, Springer, 2011.

E-RESOURCES

1. https://www.digimat.in/nptel/courses/video/108105091/L01.html
2. https://www.digimat.in/nptel/courses/video/108105091/L16.html

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LIST OF HUMANITIES AND SOCIAL SCIENCES (HS) COURSES

Course Code	Name of the Subject	Category	L	T	P	C	CIA	ESE	TOT
			Periods / Week			Credit	Maximum Marks		
19HST101	Communicative Techno English–I	HS	3	0	0	3	40	60	100
19HST201	Communicative Techno English–II	HS	3	0	0	3	40	60	100

LIST OF BASIC SCIENCES (BS) COURSES

Course Code	Name of the Subject	Category	L	T	P	C	CIA	ESE	TOT
			Periods / Week			Credit	Maximum Marks		
19MAT101	Engineering Mathematics - I	BS	3	1	0	4	40	60	100
19CYE101	Engineering Chemistry	BS	3	0	2	4	50	50	100
19PHE101	Engineering Physics	BS	3	0	2	4	50	50	100
19CYT201	Environmental Science and Engineering	BS	3	0	0	3	40	60	100
19MAT201	Engineering Mathematics – II	BS	3	1	0	4	40	60	100
19MAT301	Transforms and Partial Differential Equation	BS	3	1	0	4	40	60	100

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LIST OF ENGINEERING SCIENCES (ES) COURSES

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19GET101	Engineering Graphics	ES	3	0	0	3	40	60	100
19GEE101	Computer Fundamentals and Python Programming	ES	3	0	2	4	50	50	100
19GEE201	Basics of Electrical Machines	ES	3	0	2	4	50	50	100
19CSE303	Data Structures using C	ES	3	0	2	4	50	50	100

SCHEME FOR EEC & MC

List of Courses

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LIST OF EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19EEC101	Life Skills for Engineers	EEC	2	0	0	0	100	–	100
19EEC203	Technical Skill (Hands on training inElectrical & Electronics)	EEC	0	0	2	0	100	-	100
19EEC301	Communication Skills	EEC	0	0	2	0	100	–	100
19EEC401	Entrepreneurship Development Activities	EEC	1	0	0	0	100	–	100
19EEC501	Quantitative Aptitude Learning	EEC	2	0	0	0	100	–	100
19MDJ601	Mini Project	EEC	0	0	2	1	40	60	100
19MDJ701	Hospital/Industry Training	EEC	0	0	2	2	40	60	100
19MDJ801	Project Work	EEC	0	0	20	12	40	60	100

LIST OF MANDATORY COURSES (MC)

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19MDC101	Induction Program(2 Weeks)	MC	–	–	–	–	–	–	–
19MDC201	NSS/YRC/RRC	MC	–	–	–	–	100	–	100
19MDC301	Leadership Enhancement Programme	MC	1	0	0	0	100	–	100
19MDC401	Value Added Course – I	MC	–	–	–	–	100	–	100
19MDC501	Value Added Course – II	MC	–	–	–	–	100	–	100
19MDC601	Constitution of India	MC	3	0	0	0	100	–	100

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SCHEME

Credit Summary

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CURRICULUM AND SYLLABI

FOR B.E. / B.Tech. DEGREE PROGRAMMES

(For the Students Admitted in the Academic Year 2022-2023 onwards)

CREDIT SUMMARY

B.E.- MEDICAL ELECTRONICS

Category	Credits Per Semester								Credit Total
	I	II	III	IV	V	VI	VII	VIII	
HS	3	3	--	–	--	–	–	–	6
BS	12	7	--	4	–	--	–	–	23
ES	7	4	--	4	–	–	–	–	15
PC	–	7	22	16	14	18	7	–	84
PE	–	–	–	–	3	3	3	3	12
OE	–	–	–	–	3	--	3	3	9
EEC	–	–	–	–	–	1	2	12	15
MC	–	–	–	–	–	–	–	–	–
Total	22	21	22	24	20	22	15	18	164

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MINOR DEGREE / HONOURS

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DEPARTMENT OF   MEDICAL ELECTRONICS

REGULATION-2019

MINOR DEGREE / HONOURS

ADVANCED HEALTHCARE MANAGEMENT

CURRICULUM AND SYLLABI

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CURRICULUM AND SYLLABI
FOR B.E. / B.Tech. DEGREE PROGRAMMES
(MINOR/HONOURS DEGREE- ADVANCED HEALTHCARE MANAGEMENT)

B.E-MEDICAL ELECTRONICS

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19MDAT01	Virtual Reality and Augmented Reality In Healthcare	PC	3	0	0	3	40	60	100
19MDAT02	Robotics in Medicine	PC	3	0	0	3	40	60	100
19MDAT03	Advancements in Healthcare Technology	PC	3	0	0	3	40	60	100
19MDAE01	Data Analytics for Healthcare Technologies	PC	3	0	2	4	50	50	100
19MDAP01	Project Work	EEC	0	0	12	6	40	60	100
TOTAL CREDITS			19						

PC   :   Professional Core

EEC :   Employability Enhancement Courses

L   :   Lecture

T   :   Tutorial

P   :   Practical

C   :   Credit Point

CIA   :   Continuous Internal Assessment

ESE :   End Semester Examination

TOT :   Total

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SEMESTER III

19MDAT01   VIRTUAL REALITY AND AUGMENTED REALITY IN HEALTHCARE   L T P C
                                                                                                                              3 0 0 3

OBJECTIVES:
The student should be made to:

- Understand the virtual reality, augmented reality and using them to build Biomedical engineering applications
- Know the intricacies of these platform to develop VR with better optimality.
- Understand the concept of Content creation in Virtual reality
- Learn the possibilities of implementing target-specific VR applications on mobile.
- Know the various applications of VR.

UNIT I   INTRODUCTION   9
The three I's of virtual reality - Commercial VR technology and the five classic components of a VR system - Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers - Navigation and manipulation - Interfaces and gesture interfaces - Output Devices: Graphics displays - Sound displays & haptic feedback.

UNIT II VR DEVELOPMENT PROCESS   9
Geometric modeling - Kinematics modeling - Physical modeling - Behaviour modeling - Model management.

UNIT III CONTENT CREATION CONSIDERATIONS   9
Methodology and terminology - User performance studies - VR health and safety issues - Usability of virtual reality system - Cyber sickness - Side effects of exposures to virtual reality environment

UNIT IV VR ON THE WEB & VR ON THE MOBILE   10
JS - Pros and cons - Building blocks (WebVR, WebGL, Three.js, device orientation events) - Frameworks (A-frame, React VR) - Google VR for Android - Scripts, mobile device configuration, building to android - Cameras and interaction – Teleporting - Spatial audio - Assessing human parameters - Device development and drivers - Design Haptics.

UNIT V APPLICATIONS   8
Medical applications-military applications-robotics applications- Advanced Real time Tracking-other applications- games, movies, simulations, therapy

                                                                                                          TOTAL: 45 PERIODS

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OUTCOMES

Upon completion of the course, students will be able to:

- Analyze and Design a system or process to meet given specifications with realistic engineering constraints
- Identify problem statements and function as a member of an engineering design team
- Illustrate the implications and issues pertaining to VR
- Explain technical documents and give technical oral presentations related to design VR mini project results
- Develop simple and portable VR applications using appropriate software

TEXT BOOKS

1. Jason Jerald, "The VR Book: Human-Centred Design for Virtual Reality", Association for Computing Machinery and Morgan & Claypool, New York, USA, 2015.
2. Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles and Practice", June 2016.

REFERENCES

1. Steve Aukstakalnis, Addison-Wesley Professional , "Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability)", First Edition, 2016.

2. C. Burdea, Philippe Coiffet, "Virtual Reality Technology", Second Edition, Gregory, John Wiley & Sons, Inc., 2008.

E - RESOURCES

1. https://www.youtube.com/watch?v=04AMaTsXFJU (AR & VR)
2. https://www.youtube.com/watch?v=AttXbcLUyR0 (Virtual Reality in Medicine)

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SEMESTER IV

19MDAT02   **ROBOTICS IN MEDICINE**   **L P T C**

3 0 0 3

OBJECTIVES

The student should be made to:

- Understand the fundamentals of robotics and position analysis
- lLarn about Parallel robots, different types of motions and force analysis
- Know the basics of trajectory planning, Motion control systems and actuators
- Study the need of various sensors, image processing techniques and vision systems
- Understand the concept of Fuzzy control and Applications of Robotics in Medicine

UNIT I FUNDAMENTALS AND POSITION ANALYSIS   9

Fundamentals – Classification - Advantages and disadvantages – Components - Degrees of freedom – Joints – Coordinates - Reference frames - Programming modes - Characteristics, Workspace – Languages - Collaborative robots - Position analysis – Robots as mechanisms – Conventions – Transformations - Forward and inverse kinematics - Denavit Hartenberg Representation - Degeneracy and Dextrerity - Screw based robots - Position analysis of Articulated robot - Case studies.

UNIT II PARALLEL ROBOTS, DIFFERENTIAL MOTIONS AND FORCE ANALYSIS   9

Parallel robots: Physical characteristics - Forward and Inverse Kinematic approaches - Planar and Spatial parallel robots - Differential relationships - The Jacobian, Large scale motions - Frame vs Robot - Differential motions and change - Hand frame - Operator - Jacobian and Inverse for Screw based and Parallel Robots - Differential operator - Lagarangian mechanics, Moments of Inertia - Dynamic Equations of Multiple DOF Robots - Static force analysis - Transformation of forces and moments between coordinate frames - Case studies.

UNIT III TRAJECTORY PLANNING, MOTION CONTROL SYSTEMS AND ACTUATORS   10

Path and Trajectory - Joint Space and Cartesian Space Descriptions and Trajectory Planning - Cartesian - Trajectory Recording - Basics - Block diagrams - Laplace Transform - Block diagram Algebra - Transfer Functions - Characteristic equation - Steady state error - Root locus - Proportional, Integral and Derivative controllers - Compensators, Bode, Loops, Multiple IO systems - Control - State space and Digital, Nonlinear systems - Characteristics of Hydraulic, Pneumatic, Electric motors - Other actuators - Speed reduction - Case studies

UNIT IV SENSORS, IMAGE PROCESSING AND ANALYSIS WITH VISION SYSTEMS   9

Sensor Characteristics: Position, Velocity, Acceleration, Force, Pressure and Torque. Microswitches - Visible and IR, Touch, Proximity, Range finders, Sniff, Vision, Transforms – Fourier, Hough, Resolution, Quantization, Sampling, Image processing - Segmentation, Region growing and splitting, Operations, Object recognition, Depth, Specialized lighting, Compression, Colour images, Heuristics - Case studies

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UNIT V FUZZY CONTROL AND APPLICATIONS IN MEDICINE **8**

Fuzzy control - Crisp vs Fuzzy, Sets, Inference rules, Defuzzification, Simulation - Applications in Biomedical Engineering - Applications in rehabilitation - Nanobots in medicine - Clinical diagnosis and Surgery - Cardiac and abdominal procedures with teleoperated robots - Orthopedic surgery with cooperative robots Case studies

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, students will be able to
- Describe the fundamentals of robotics and position analysis
- Outline the functioning of parallel robots, different types of motions and force analysis
- Illustrate the basics of trajectory planning, Motion control systems and actuators.
- Explain the use of various sensors and vision systems in robotics.
- Apply Fuzzy control in robotics and Robotics in Medicine

TEXT BOOKS
1. Olfa Boubaker, "Medical and Healthcare Robotics", First Edition - August 1, 2023
2. S. B. Niku, "Introduction to Robotics, Analysis, Control, Applications", 2020

REFERENCES
1. João Silva Sequeira, "Robotics in Healthcare", First Edition, 18 February 2020
2. Achim Schweikard, Floris Ernst, "Medical Robotics", First Edition, 19 October 2015

E-RESOURCES
1. https://www.youtube.com/watch?v=rYWJdZ5qg6M&list=PLbRMhDVUMngcdUbBySzyz cPiFTYWr4rV_ (Fundamentals of Robotics)
2. https://onlinecourses.nptel.ac.in/noc21_me49/preview (Robotics and Control)

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SEMESTER V

19MDAT03   **ADVANCEMENTS IN HEALTHCARE TECHNOLOGY**   **L T P C**
                                                              3 0 0 3

OBJECTIVES

The student should be made to:
- Understand the need for digital methods of handling medical records.
- Study the functions of digital radiology
- Learn about the tools and methods for work flow in E-Health
- Know the available technology in mobile healthcare and wearable healthcare devices
- Study the various standards for inter-operability of devices, quality and safety standards for developing healthcare systems

UNIT I   DIGITAL HEALTH   9

Digital Health: Requirements and best practices - Laws and regulations in Digital health - Ethical issues - Barriers and strategies for innovation.

UNIT II DIGITAL RADIOLOGY   9

Digital radiology for digital hospital - Picture archiving and communication - System integration, digital history of radiology - Medical image archives - Storage and networks.

UNIT III E-HEALTH   9

E-Health: Health care networking - Medical reporting using speech recognition - Physiological tests and functional diagnosis with digital methods - Tele-consultation in medicine and radiology.

UNIT IV M-HEALTH CARE AND WEARABLE DEVICES   9

Introduction to mobile healthcare devices - Economy - Average length of stay in hospital - Outpatient care - Health care costs - Mobile phones - 4G - Smart devices - Wearable devices - Uptake of e-health and m-health technologies – Standards - System Design and case study.

UNIT V MODALITY AND STANDARDS FOR INTER-OPERABILITY   9

Multimodality registration in daily clinical practice - Mobile healthcare - Selection and Implementation in e-Health project - Design of medical equipment based on user needs - Security and privacy in digital health care - Case study.

                                                                TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the student will be able to
- Analyze the need for digital methods of handling medical records
- Explain the digital radiology
- Apply the tools and methods for work flow in E-Health
- Identify the available technology for wearable healthcare devices
- Classify various standards for inter-operability of devices, quality and safety standards for developing healthcare systems

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TEXT BOOKS.
1. Christoph Thuemmler, Chunxue Bai, "Health 4.0: How Virtualization and Big Data are Revolutionizing Healthcare", Springer, First Edition, 2017
2. Wlater Hruby, "Digital revolution in radiology – Bridging the future of health care", Second Edition, Springer, New Yorkm, 2006.

REFERENCES
1. Rick Krohn (Editor), David Metcalf, Patricia Salber, "Health-e Everything: Wearables and The Internet of Things for Health", 2013.
2. Samuel A. Fricker, Christoph Thummler , Anastasius Gavras, "Requirements Engineering For Digital Health", Springer, 2015

E-RESOURCES
1. https://www.youtube.com/watch?v=l-WE30LqXjc (Health 4.0)
2. https://nptel.ac.in/courses/110104095   (Economics of Health and Health Care)

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SEMESTER VI

19MDAE01   DATA ANALYTICS FOR HEALTHCARE TECHNOLOGIES   L T P C
3 0 2 4

OBJECTIVES:
The student should be made to:
- Study the various forms of electronic health care information
- Learn the techniques adopted to analyze health care data
- Understand the natural language based analytics
- Study the predictive models for clinical data
- Know about health care analytics and its applications
- Learn the advanced health care analytic system

UNIT I   INTRODUCTION   9
Introduction to Healthcare Data Analytics - Electronic Health Records - Components of HER - Coding Systems - Benefits of EHR- Barrier to Adopting HER - Challenges - Phenotyping Algorithms.

UNIT II   DATA ANALYSIS   9
Biomedical Image Analysis - Mining of Sensor Data in Healthcare - Biomedical Signal Analysis Genomic Data Analysis for Personalized Medicine

UNIT III   ANALTICS   9
Natural Language Processing and Data Mining for Clinical Text - Mining the Biomedical - Social Media Analytics for Healthcare.

UNIT IV   ADVANCED ANALYTICS   9
Advanced Data Analytics for Healthcare - Review of Clinical Prediction Models - Temporal Data Mining for Healthcare Data - Visual Analytics for Healthcare - Predictive Models for Integrating Clinical and Genomic Data - Information Retrieval for Healthcare - Privacy - Preserving Data Publishing Methods in Healthcare

UNIT V   APPLICATIONS   9
Applications and Practical Systems for Healthcare - Data Analytics for Pervasive Health Fraud Detection in Healthcare - Data Analytics for Pharmaceutical Discoveries - Clinical Decision Support Systems - Computer Assisted Medical Image Analysis Systems - Mobile Imaging and Analytics for Biomedical Data.

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LIST OF EXPERIMENTS

1. Study of open source software
2. Medical data storage and retrieval
3. Creation of electronic patient record
4. Web page creation and digital Marketing
5. Preprocessing the given dataset
6. User interface design
7. Univariate and Multivariate regression
8. Multimedia and power BI presentation

TOTAL: 45 +15=60 PERIODS

OUTCOMES

Upon completion of this course, the student will be able to

- Explain the various forms of electronic health care information
- Evaluate the techniques adopted to analyze health care data
- Implement the natural language based analytics
- Illustrate the predictive models for clinical data
- Apply health care analytics and its applications in medical field.
- Design advanced digital healthcare analytic system for the betterment of hospitals and healthcare.

TEXT BOOKS

1. Chandan K. Reddy and Charu C Aggarwal, "Healthcare data analytics", Taylor & Francis, 2015
2. Hui Yang, Eva K. Lee, "Healthcare Analytics: From Data to Knowledge to Healthcare Improvement", Wiley, 2016.

REFERENCES

1. Michael Berthold, David J.Hand, "Intelligent Data Analysis", Springer, 2007.
2. David J. Lubliner , "Biomedical Informatics: An Introduction to Information Systems and Software in Medicine and Health", CRC Press, Boca Raton, 2016

E-RESOURCES

1. https://onlinecourses.nptel.ac.in/noc21_cs45/preview (Data Analytics with Python)
2. https://onlinecourses.nptel.ac.in/noc22_hs40/preview (Exploring Survey Data on Health Care)

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SEMESTER VII

19MDAP01	PROJECT WORK	L T P C
		0 0 12 6

OBJECTIVES

- To understand a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To study the skills needed to formulate a technical project.
- To learn the methodology to solve the identified problem.
- To study the use of new tools, algorithms and techniques required to carry out the projects
- To understand about preparing project reports and face reviews and viva-voce

GUIDELINE FOR REVIEW AND EVALUATION

The students in a group of 4 works on a topic approved by the head of the department under the guidance of a faculty member who is familiar in this area of interest. The student can select any topic which is relevant to the area of engineering design. The topic may be theoretical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 15 PERIODS

OUTCOMES

Upon completion of the project, the students will be able to:

- Analyze the real world problem, identify the requirement and develop the design solutions
- Identify the technical ideas, strategies and methodologies
- Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project
- Develop technical report and oral presentations
- Categorize any challenging practical problems and find solution by formulating proper methodology

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FOR B.E./ B.Tech. DEGREE PROGRAMMES

(MINOR DEGREE /HONOURS - Advanced Healthcare Management)

CREDIT SUMMARY

B.E.- MEDICAL ELECTRONICS

Category	Credits Per Semester								Credit Total
	I	II	III	IV	V	VI	VII	VIII	
HS	-	-	-	-	-	-	-	-	-
BS	-	-	-	-	-	-	-	-	-
ES	-	-	-	-	-	-	-	-	-
PC	-	-	3	3	3	4	-	-	13
PE	-	-	-	-	-	-	-	-	-
OE	-	-	-	-	-	-	-	-	-
EEC	-	-	-	-	-	-	6	-	6
MC	-	-	-	-	-	-	-	-	-
Total	-	-	3	3	3	4	6	-	19