B.Tech. BIOMEDICAL ENGINEERING
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FOREWORD

There is always a growing demand for hospitals, industries, research and development organizations, so is for individuals with knowledge and skills to apply computing and mathematical skills to problems in the healthcare and biological research. The practice of medicine and biomedical research and development is becoming increasingly multidisciplinary in its disposition, with a particular prominence on the widespread application of computers and electronics.

B. Tech Program in Biomedical Engineering, imparts students with critical understanding of how biological, medical knowledge interacts with engineering knowledge to produce engineering solutions to healthcare problems. The new curriculum of R22 accomplishes multidisciplinary holistic education, continuous assessment along with multiple honorable exit options if a student fails to complete the requirements to earn the degree within the stipulated period including the permissible spill over period.

R22 curriculum unique features:

- Revision in tune with National Education Policy 2020
- Various exit options
- Regular Degree along with Honours / Minor Degree
- Module wise course syllabus
- Practice based Learning.
- Interdepartmental, Societal Centric and Industry Related Projects.
- Frequent hospital and industrial visits to acquire hands-on experience on medical instruments.
- Advanced courses in the field of biomedical to make students ready for employment.
- Pool of electives on advanced medical technologies
- Credits to online courses like NPTEL, MOOCS
- Modular and Value added Courses taught with industrial experts and collaborations such as Andhra Pradesh Med Tech Zone (AMTZ), TMI Systems, GEMN R&D Pvt. Ltd., Skanray Technology Pvt. Ltd.
- Modular Course & Value added courses.

R-22 Course is designed in a way to accommodate and address the knowledge, skills required to solve the future health care problems for industry ready graduates, and entrench confidence and success in competitive examinations like GATE, GRE and Engineering Services.

The Board of studies of BME consists of eminent personalities from academia, industry, hospitals and research organizations in addition to experienced faculty members of the VFSTR.

External BoS Members:

1. Dr. M. Ramasubba Reddy, Professor, IIT, Madras.
2. Dr. M. Malini, Professor, Biomedical Engineering, Osmania University, Hyderabad.
3. Dr. Amarnath, Doctor, Amar Orthopaedic Hospital, Guntur.

I thank all the BoS Members, Academic Council Members and University authorities for encouraging us to design this innovative curriculum for our students.

Ms. Prathiba Jonnala
BoS Coordinator

Dr. Sitaramanjaneya Reddy Guntur
HoD, BME

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

VISION

To evolve into a Centre of Excellence in Science & Technology through creative and innovative practices in teaching – learning, towards promoting academic achievement and research excellence to produce internationally accepted, competitive and world class professionals who are psychologically strong & emotionally balanced, imbued with social consciousness & ethical values.

MISSION

To provide high quality academic programmes, training activities, research facilities and opportunities supported by continuous industry - institute interaction aimed at promoting employability, entrepreneurship, leadership and research aptitude among students and contribute to the economic and technological development of the region, state and nation.

Department of
BIOMEDICAL ENGINEERING

VISION of the department

The Vision of biomedical engineering is to become a knowledge beacon for Biomedical medical technology for the prosperity of the medical society, ensuring quality in health care, education and research.

MISSION of the department

To develop clinically translatable solutions for human health by training the next generation of biomedical engineers through project based learning, cultivating leaders, and nurturing the integration of science, engineering, and medicine in an innovative centered environment.

R22 B.Tech.
4 YEAR
DEGREE PROGRAMME

COURSE STRUCTURE - R22

I Year I Semester

Course Code	Course Title	L	T	P	C
22MT101	Elementary Mathematics	3	2	-	4
22PY101	Applied Physics	2	-	2	3
22EE101	Basic of Electrical & Electronics Engineering	2	-	2	3
22BCS103	IT Workshop and Tools	-	2	4	3
22TP103	Programming in C	2	-	4	4
22EN102	English Proficiency & Communication Skills	-	-	2	1
22SA101	Physical Fitness, Sports & Games – I	-	-	3	1
22TP101	Constitution of India	-	2	-	1
Total		**9**	**6**	**17**	**20**
		32 Hrs			

I Year II Semester

Course Code	Course Title	L	T	P	C
22MT110	Matrices and Differential Equations	3	2	-	4
22ME101	Engineering Graphics	2	-	2	3
22TP104	Basics Coding Competency	-	1	3	2
22EN104	Technical English Communication	2	-	2	3
22BM101	Clinical Biochemistry	2	-	2	3
22BM102	Fundamentals of Anatomy and Physiology	2	1	2	4
22SA103	Physical Fitness, Sports & Games – II	-	-	3	1
22SA102	Orientation Session	-	-	6	3
Total		**10**	**4**	**21**	**23**
		35 Hrs			

Department Subject is extension of Basic sciences

R22 B.Tech.

4 YEAR

DEGREE PROGRAMME

COURSE STRUCTURE - R22

II Year I Semester

Course Code	Course Title	L	T	P	C
22CT201	Environmental Studies	1	1	-	1
22TP201	Data Structures	2	2	2	4
22BM201	Analog Electronic Circuits	2	2	2	4
22BM202	Basic Clinical Sciences	2	2	-	3
22BM203	Electrical Circuit Theory	2	2	-	3
22BM204	Biomedical Instrumentation	2	2	2	4
22BM205	Hospital Management	2	2	-	3
22SA201	Life Skills	-	-	2	1
Total		**13**	**13**	**8**	**23**
	NCC/ NSS/ SAC/ E-cell/ Student Mentoring/ Social activities/ Publication with good impact factor (Only 2 students can claim 1 paper /patent). These credits maybe earned on or before the end of IV semester	-	-	-	1
Total		**13**	**13**	**8**	**24**
		34 Hrs			

II Year II Semester

Course Code	Course Title	L	T	P	C
22ST204	Biostatistics	3	2	-	4
22TP203	Advanced Coding Competency	-	-	2	1
22BM206	Analog and Digital ICs	2	2	2	4
22BM207	Biomaterials and Artificial Organs	2	2	-	3
22BM208	Biomedical Signals and Systems	2	1	2	4
22TP204	Professional Communication	-	-	2	1
	Open Elective – 1	2	2	-	3
22SA202	Life Skills -II	-	-	2	1
Total		**11**	**7**	**12**	**21**
	Minor / Honours - 1	3	-	2	4
		14	**7**	**14**	**25**
Total		**35 Hrs**			

COURSE STRUCTURE - R22

III Year I Semester

Course Code	Course Title	L	T	P	C
22BM301	Analog and Digital Communication	2	-	2	3
22BM302	Microprocessors and Microcontrollers	2	2	2	4
22BM303	Diagnostic and Therapeutic Equipments	2	-	2	3
22BM304	Biomechanics	2	-	2	3
22EE306	On-site training	-	-	4	2
	Open Elective – 2	2	2	-	3
22BM306	Inter-Departmental Project –Phase I	-	-	2	-
22TP301	Soft Skills Lab	-	-	2	1
	Total	**10**	**4**	**16**	**18**
	NCC/ NSS/ SAC/ E-cell/ Student Mentoring/ Social activities/ Publication with good impact factor (Only 2 students can claim 1 paper /patent). These credits maybe earned on or before the end of VI semester	-	-	-	1
	Minor / Honours - 2	3	-	2	4
	Total	**13**	**4**	**18**	**24**
		35 Hrs			

III Year II Semester

Course Code	Course Title	L	T	P	C
22TP302	Quantitative Aptitude & Logical Reasoning	1	2	-	2
22BM307	Biomedical Signal Processing	2	2	2	4
22BM308	Medical Imaging Modalities	2	2	-	3
	Department Elective – 1	2	2	-	3
	Department Elective –2	2	2	-	3
	Open Elective – 3	2	2	-	3
22BM309	Industry Interface Course (Modular course)	1	-	-	1
22BM310	Inter-Departmental Project-Phase II	-	-	2	2
	Total	**12**	**12**	**4**	**21**
	Minor / Honours - 3	3	-	2	4
	Total	**15**	**12**	**6**	**25**
		33 Hrs			

R22 B.Tech.

4 YEAR DEGREE PROGRAMME

COURSE STRUCTURE - R22

IV Year I Semester

Course Code	Course Title	L	T	P	C
22BM401	Biosensors and Transducers	2	2	2	4
22BM402	Medical Image Processing	2	2	2	4
	Department Elective – 3	2	2	-	3
	Department Elective – 4	2	2	-	3
	Department Elective – 5	2	2	-	3
	Department Elective – 6	2	2	-	3
	Total	**12**	**12**	**4**	**19**
	Minor / Honours – 4	3	-	2	4
	Total	**15**	**12**	**6**	**24**
		33 Hrs			

IV Year II Semester

Course Code	Course Title	L	T	P	C
22EC403 / 22EC404	Project Work / Internship	-	23	22	12
	Total	**24**			**12**
	Minor / Honours – 5 (for project)	-	2	6	4
	Total	**32 Hrs**			**16**

for interaction between Guide and students

COURSE STRUCTURE - R22

Department Electives

Course Code	Course Title	L	T	P	C
22BM801	Medical Informatics	2	2	-	3
22BM802	Assist Devices and Implant Technology	2	-	2	3
22BM803	Physiological Control Systems	2	2	-	3
22BM804	Biofluids and Dynamics	2	2	-	3
22BM805	Embedded System and IoT in Health Care	2	-	2	3
22BM806	Rehabilitation Engineering	2	2	-	3
22BM807	Fiber Optics and Lasers in Medicine	2	-	2	3
22BM808	Telemedicine	2	2	-	3
22BM809	Soft Computing Techniques	2	-	2	3
22BM810	Medical Physics	2	2	-	3
22BM811	Medical Equipment Maintenance and Troubleshooting	2	-	2	3
22BM812	Robotics and Automation in Medicine	2	-	2	3
22BM813	Machine Vision in Medical Technology	2	-	2	3
22BM814	Virtual Bio-Instrumentation	2	-	2	3
22BM815	Virtual Reality	2	2	-	3
22BM816	VLSI for Bioengineers	2	0	2	3

Course Code	Course Title	L	T	P	C
Honours Courses					
22BM951	Assist Devices and Implant Technology	3	2	-	4
22BM952	Embedded Systems for Medical Devices	3	2	-	4
22BM953	Biofluids and Dynamics	3	2	-	4
22BM954	Medical Physics	3	2	-	4
22BM955	Machine Vision in Medical Technology	3	-	2	4
22BM956	Soft Computing Techniques	3	2	-	4
22BM957	Robotics and Automation in Medicine	3	-	2	4
22BM958	Virtual Reality	3	-	2	4

R22 B.Tech.

4 YEAR

DEGREE PROGRAMME

COURSE STRUCTURE - R22

Course Code	Course Title	L	T	P	C
Minor - Medical Instrumentation					
22BM901	Clinical Instrumentation	3	2	-	4
22BM902	Diagnostic and Therapeutic Equipments	3	-	2	4
22BM903	Biomedical Signal Processing	3	-	2	4
22BM904	Medical Imaging Modalities	3	2	-	4
22BM905	Medical Image Processing	3	-	2	4
OPEN ELECTIVE COURSES					
22BM851	Basic Clinical Sciences	2	2	-	3
22BM852	Biomedical Instrumentation	2	-	2	3
22BM853	Diagnostic and Therapeutic Equipments	2	-	2	3
22BM854	Medical Imaging Modalities	2	2	-	3
22BM855	Biomaterials	2	-	2	3
22BM856	Biomechanics	2	-	2	3

I

YEAR

BIOMEDICAL ENGINEERING

B.Tech.

I SEMESTER

22MT101	-	Elementary Mathematics
22PY101	-	Applied Physics
22EE101	-	Basic of Electrical & Electronics Engineering
22CS102	-	IT Workshop and Tools
22TP103	-	Programming in C
22EN102	-	English Proficiency and Communication Skills
22SA101	-	Physical Fitness, Sports & Games-I
22TP101	-	Constitution of India

II SEMESTER

22MT111	-	Matrices and Differential Equations
22ME101	-	Engineering Graphics
22TP104	-	Basic Coding Competency
22EN104	-	Technical English Communication
22BM101	-	Clinical Biochemistry
22BM102	-	Fundamentals of Anatomy and Physiology
22SA103	-	Physical Fitness, Sports & Games – II
22SA102	-	Orientation Session

COURSE CONTENTS

I SEM & II SEM

22MT101 ELEMENTARY MATHEMATICS

Image Source: https://thumbs.dreamstime.com/z/linear-algebra-complex-like-puzzle-pictured-as-word-linear-algebra-puzzle-pieces-to-show-linear-algebra-can-be-164220956.jpg

Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Basics of Geometry and Algebra.

COURSE DESCRIPTION AND OBJECTIVES:

The objective of the course is to make student acquainted with preliminary concepts of mathematics that are useful for their engineering study. Students will learn concepts of progression, partial fractions, straight line, trigonometry, calculus which will help them to apply in various aspects of engineering fields.

MODULE-1

UNIT-1 **12L+8T+0P=20 Hours**

MATHEMATICAL PRELIMINARIES:

Partial fractions, Arithmetic progressions, Geometric progressions.

UNIT-2 **12L+8T+0P=20 Hours**

STRAIGHT LINES AND TRIGONOMETRIC RATIOS:

Straight Lines: Point in coordinate plane, distance formula, straight line, slope, equation of straight in different forms.

Trigonometric Ratios: Trigonometric ratios, values in different quadrants, compound angels, multiple angles.

PRACTICES:

- Splitting a given improper fraction
- Finding the general term and sum of infinite terms of a progression.
- Finding equation of a straight line in various form
- Find the tangent and normal.
- Evaluation of trigonometric function.

MODULE-2

UNIT-1 **12L+8T+0P=20 Hours**

CALCULUS:

Differential Calculus: Introduction to differentiation, Derivatives of simple functions, Product rule, Quotient rule and Chain rule of differentiation.

Integral calculus: Integration as anti-derivative process, Standard forms, Methods of integration: by substitution, by parts, and by partial fractions.

Definite integration.

UNIT-2 **12L+8T+0P=20 Hours**

APPLICATIONS OF CALCULUS:

Tangent, normal, velocity and acceleration.

Evaluation of length and area by integration.

SKILLS:

- ✓ *Focusing on Trigonometric Ideas.*
- ✓ *Know the various trigonometric functions.*
- ✓ *Understanding the Applications of Trigonometry and straight lines.*
- ✓ *Understand basic applications of calculus.*

PRACTICES:

- To calculate the profit and loss in business using graphs.
- To check the temperature variation.
- To determine the speed or distance covered.
- Derivatives and integration are used to derive many equations in physics.
- In the study of seismology like to find the range of magnitudes of the earthquake.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the concepts of straight line in real life problems.	Apply	1	1, 2, 9, 10, 12
2	Apply the concepts of calculus in real life problem	Apply	2	1, 2, 9, 10, 12
3	Distinguish between finite and infinite AP and determine the general term.	Analyse	1	1, 2, 9, 10, 12
4	Categorize right angle triangles to evaluate the trigonometric ratios.	Analyse	2	1, 2, 9, 10, 12

TEXT BOOKS:

1. John Bird, “Higher Engineering Mathematics”, 2nd edition, Routledge (Taylor & Francis Group), London, New York, 2018.
2. Veerarajan, T., “Engineering Mathematics”, 3rd edition, Tata McGraw Hill Publishing Co., New Delhi, 2019.

REFERENCE BOOKS:

1. P. Kandasamy, K. Thilagavathy, K.Gunavathy, “Engineering Mathematics”, revised edition, S. Chand & Co., New Delhi,2017.
2. P. Seshagiri Rao, “A Text Book of Remedial Mathematics”, 3rd edition, PharmaMed Press / BSP Books, 2018.
3. Nabjyoti Dutta, Bulendra Limboo, Bismeeta Buragohain, Pranjal Talukdar, “A Basic Course in Mathematics for Polytechnic Vol.1, Vol.2”, 2nd Edition, Mahaveer Publications, 2017.

22PY101 APPLIED PHYSICS

https://www.ge.com / research/ technology-domains/ biology- applied-physics

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Basics of atomic structure and electronic transitions, Bonding in solids, and concept of waves.

COURSE DESCRIPTION AND OBJECTIVES:

The purpose of this course is to present the principles and concepts of Light and Sound waves. It enunciates the concurrent understanding of Lasers and Optical Fibers. It emphasizes on the principles and applications of Nano materials as relevant to an Engineer.

MODULE-1

UNIT-1 **8L+0T+8P = 16 Hours**

PHYSICAL OPTICS:

Interference: Introduction-Superposition principle -Types of superposition of waves – Division of wave front, Division of amplitude, Newton rings - Experiment – Diameter of Newton rings (bright & dark), Determination of wavelength – Determination of Refractive Index.

Diffraction: Introduction- Interference versus Diffraction – Types of diffraction, Fraunhofer diffraction at single and double slit (Qualitative), Plane transmission diffraction grating (Qualitative) – Determination of wavelength.

Polarization: Polarized and unpolarized light, Production of polarized light, Nicol prism, Quarter and half wave plates, Optical activity - Laurent's half shade polarimeter.

UNIT-2 **8L+0T+8P = 16 Hours**

LASERS AND FIBRE OPTICS:

LASERS: Characteristics of laser light – spontaneous and stimulated emission, Population Inversion – Pumping Processes –He-Ne laser, Semiconductor laser and applications of lasers, Holography – construction – reconstruction and applications.

Fiber Optics: Principle of optical fibre – acceptance angle, numerical aperture, Types of fibres – Step Index fiber – Gradded Index fiber - Fibre optic sensor - Biosensors

PRACTICES:

- Newtons rings: Determination of wavelength of a given light source.
- Diffraction grating: Determination of wavelength – Normal Incidence method.
- Polarimeter: Determination of Optical rotation of an optically active solution.
- Laser: Determination of wavelength of a given LASER source using plane diffraction grating.

MODULE-2

UNIT-1 **8L+0T+8P = 16 Hours**

CRYSTAL PHYSICS:

Crystal Physics: Crystal Physics: - Introduction-Fundamental terms of crystal physics, Lattice parameters and Crystal systems, packing factor for SC, BCC and FCC –Miller indices – Rules to find Miller Indices – Important features of Miller Indices – Distance of separation between successive (h k l) planes (Qualitative), XRD and Bragg's law

SKILLS:

- ✓ *Apply the dynamics of Light to realize the various potential applications in Engineering.*
- ✓ *Evaluate the concepts of Lasers and Optical Fibers to realize versatile applications in Science, Engineering and Technology.*
- ✓ *Analyze the Crystal Structures and orientation of planes.*
- ✓ *Appraise the importance of Ultrasonics in medicine.*
- ✓ *Demonstrate the synthesis and characterization of Nano materials in view of their applications.*

UNIT-2 **8L+0T+8P = 16 Hours**

ELEMENTS OF NANOMATERIALS:

Elements of Nano Materials: Introduction- Principles of Nano materials, Synthesis of Nanomaterials: top- down and bottom- up approaches – Ball milling – Sol-gel, Applications of nanomaterials, Characterization of nanomaterials by electron microscopy (SEM-Construction – Working – Applications), TEM- (Construction – Working – Applications), AFM – Construction – Working – Applications.

PRACTICES:

- Band gap: Determination of Energy bandgap of a semiconductor.
- Optical fibre: Determination of a Numerical Aperture of an Optical Fibre
- LED: Study of V-I characteristics of LED
- Ultrasonic interferometer: Determination of ultrasonic wave velocity in liquid medium.

COURSE OUTCOMES:

Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the concepts of physical optics in the perspective of Engineering applications	Apply	1	1, 3, 5, 6, 7
2	Analyse the wavelengths of laser for applications in medicine and to foster the knowledge on Optical Fibers to realize fiber optic sensors	Analyze	1	1, 3, 5, 6, 7
3	Recognise the importance of crystal physics relevant to Bio-Physical systems	Apply	2	1, 2, 4, 5, 6, 7, 9
4	Evaluate ultrasonic waves to apply them in medical diagnostics	Evaluate	2	1, 2, 4, 5, 6, 7, 9
5	Connect the dimensions of nano particles to consolidate the physical and chemical aspects of nano materials	Analyze	2	1, 3, 5, 6, 9, 11, 12

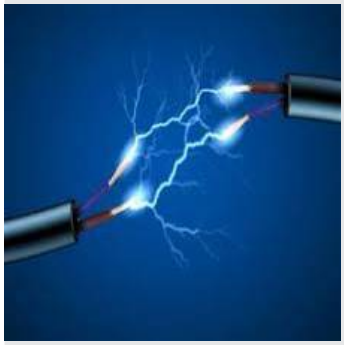
TEXT BOOKS:

1. S.O. Pillai, “Solid State Physics”, New age International publishers, 8th edition, 2018.
2. M.R. Srinivasan, “Engineering Physics”, New Age International Publishers, 1st edition 2008.

REFERENCEBOOKS:

1. M.N. Avadhanulu, P.G. Kshirsagar and T.V.S. Aruen Murthy, “A Text Book of Engineering Physics”, 11th edition, S. Chand & Company Ltd., 2019.
2. Shatendra Sharma and Jyotsna Sharma, “Engineering Physics”, Pearson India Education Services Pvt. Ltd., 2018.
3. D. Halliday, R. Resnick and J. Walker “Fundamentals of Physics”, 6th edition, John Wiley and Sons, 2020.
4. T. Pradeep, “A Text Book of Nanoscience and Nanotechnology”, Tata Mc-Graw Hill, 2018.

22EE101 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING



Source : https://vita.vision.org.in/emerging-technologies-in-electrical-engineering/

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Electrostatics and Electromagnetism.

COURSE DESCRIPTION AND OBJECTIVES:

This course provides an insight into the functioning of basic electrical components like resistor, inductor and capacitor. It deals with the constructional and operational details of AC machines. It also deals with the basic electronic components like P-N junction diode, Zener diode, Transistor and their characteristics.

MODULE–1

UNIT-1 **8L+0T+8P=16 Hours**

FUNDAMENTALS OF ELECTRIC CIRCUITS:

DC Circuits: Concept of network, Active and passive elements, Voltage and current sources, Concept of linearity and linear network, Unilateral and bilateral elements, R, L and C as linear elements, Ohm's Law, Kirchhoff's Laws, Application to simple series, Parallel circuits, Mesh and nodal analysis of resistive circuits with DC source.

AC circuits: Generation of AC voltage, Frequency, Average value, R.M.S. value, Form factor, Peak factor for sinusoidal only.

UNIT-2 **8L+0T+8P=16 Hours**

SEMICONDUCTOR DEVICES:

Classification of semiconductors, P-N junction diode -operation and its characteristics, Half wave rectifier - operation, efficiency; Full wave rectifiers -types, operation, efficiency; Zener diode and its characteristics, Zener diode as Voltage regulator.

Bi polar junction transistor- operation, types (NPN & PNP).

PRACTICES:

- Verification of Ohm's law.
- Verification of Kirchhoff's current law.
- Verification of Kirchhoff's voltage law.
- Determination of R.M.S. Values of sinusoidal waveform.
- Verification of PN junction diode characteristics under both forward and reverse bias.
- Verification of Zener diode characteristics under reverse bias.

MODULE–2

UNIT-1 **8L+0T+8P=16 Hours**

ANALYSIS OF AC CIRCUITS:

Analysis of single- phase ac circuits consisting of R, L, C, RL, RC (series and parallel) (simple numerical problems). Introduction to three phase system, Relation between phase and line quantities of voltages and currents in star and delta connected systems (Elementary treatment only).

SKILLS:

- ✓ *Distinguish between linear and nonlinear elements by looking at VI characteristics.*
- ✓ *Develop a simple loop generator.*
- ✓ *Design a voltage regulator using Zener diode.*
- ✓ *Design a half wave rectifier using PN junction diode.*
- ✓ *Design a full wave rectifier using PN junction diodes.*

UNIT-2 **8L+0T+8P=16 Hours**

AC MACHINES:

Electromagnetism: Concepts of Magneto motive force, Reluctance, Flux and flux density, Concept of self-inductance and mutual inductance, Coefficient of coupling.

Static & Rotating AC Machine: Principle of operation of single phase transformer, Constructional features, EMF equation (simple numerical problems).

Rotating AC Machine principle of operation of three phase induction motor, Slip ring and squirrel cage motors, Torque equation; Constructional details of synchronous machine.

PRACTICES:

- Transformation ratio of a single phase transformer at different loads.
- Measurement of Energy in single phase resistive load circuit.
- Measurement of Power in single phase resistive load circuit
- Determination of impedance in complex AC circuits.
- Verification of line and phase quantities in a balanced three phase system.

COURSE OUTCOMES:

Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Solve the AC (single and three phase) and DC circuits using different methods.	Apply	1,2	1,2,9,12
2	Apply the concepts of electromagnetism for its applications.	Apply	2	1,2,3,9,12
3	Analyze the resistive circuits with independent sources and find its solution.	Analyze	1,2	1,2,6,9
4	Examine the different electrical equipment.	Evaluate	2	1,2,9,12
5	Acquire the knowledge of semiconductor devices to create circuits.	Create	1	1,2,3,9,12

TEXT BOOKS:

1. V. K. Mehta, “Principles of Electrical Engineering and Electronics”, S.Chand& Co., Publications, New Delhi, 2019.
2. D.P. Kothari, “Basic Electrical and Electronics Engineering”, TMH, New Delhi, 2017.

REFERENCE BOOKS:

1. Millman and Halkias, “Electronic Devices and Circuits”, Mc Graw Hill, 2006.
2. A.K. Thereja and B.L.Thereja, “Electrical Technology”, Vol.–II, S. Chand & Co., Publications, 2020.
3. U. Bakshi and A. Bakshi, “Basic Electrical Engineering”, 1st edition, Technical Publications, Pune, Nov 2020.

22CS102 IT WORKSHOP AND TOOLS

sOURCE : https://bright-industry.com/electrical-engineering

Hours Per Week :

L	T	P	C
0	2	4	3

PREREQUISITE KNOWLEDGE: Basics hardware knowledge.

COURSE DESCRIPTION AND OBJECTIVES:

This course enables the students to learn various components of a computer system, assembly and dis-assembly of various components, troubleshoot, installation of OS and other applications. Also practicing of the usage of software tools such as word, excel, ppt and LaTex, text and image editors.

MODULE-1

0L+16T+32P=48 Hours

PRACTICING EXERCISES ON HARDWARE DEVICES:

- Demo of various physical components of a computer system.
- Integration of various components of a computer system and dismantling.
- Installation of OS in a computer system through various storage devices.
- Installation of OS in a computer system through cloning.
- Demonstration of booting process of a computer system
- Detection of faulty components in a computer system hard disk, RAM, SMPS, network interface.
- Demonstration of program execution environment
- Demo of file system.
- Demo of location OS files in the file system
- Configuration of network device and troubleshooting of network connectivity issues.
- Demo of shell scripts for maintenance and administration of a computer system
- Usage of editor tools
- Installation of software tools such as C compiler / interpreter, Java IDE, Python IDLE, Pycharm.
- Installation of antivirus software, web browsers and creation of Email ID's.

MODULE-2

0L+16T+32P=48 Hours

PRACTICING EXERCISES ON SOFTWARE TOOLS:

- Prepare your resume using MS-word
- Design a "Birthday Invitation" card.
- Design a Time Table given to you at the beginning of the semester without grid lines.
- Using Draw Table feature, insert a 7-column, 6-row table to create a calendar for the current month.
  a. Enter the names of the days of the week in the first row of the table.
  b. Centre the day names horizontally and vertically.
  c. Change the font and font size as desired.
  d. Insert a row at the top of the table.
  e. Merge the cells in the row and enter the current month and year using a large font size.
  f. Shade the row.
  g. Enter and right-align the dates for the month in the appropriate cells of the table.
  h. Change the outside border to a more decorative border. Identify two important dates in the calendar and shade them.
- Prepare mark sheet using MS-Excel.
- Create a worksheet as shown below:
  a. Sort the data in the "Type" column. Filter the areas where "Rice" is supplied.
  b. Use PivotTable in the below worksheet that uses the SUM function in the quantity. Change the SUM function to AVERAGE or COUNT.
  c. Add/modify one or two new records to the worksheet, and then reset the range for the PivotTable.

SKILLS:

- ✓ *Creating the documents using MS-Word and LaTex.*
- ✓ *Analysing and visualizing data with excel.*
- ✓ *Understand what kind of Pow-erPoint you're creating.*

A	B	C	D
Distribution of food items within different areas			
Jan	Mayur Vihar	Rice	37000
Feb	Patparganj	Wheat	25500
Mar	Vivek Vihar	Sugar	15000
Apr	Vivek Vihar	Rice	13000
May	Vivek Vihar	Wheat	15500
Jun	Vivek Vihar	Maize	22000
Jul	Masjid Moth	Rice	17500
Aug	Masjid Moth	Wheat	21000
Sep	Masjid Moth	Sugar	29500
Oct	Masjid Moth	Maize	12900
Nov	Pltampura	Rice	25000
Dec	Pltampura	Wheat	21600

- Prepare a presentation on your university using MS-PowerPoint
- Design a Magazine cover. Use the following:
  - Select a theme for the page,
  - Insert either a picture or clipart, and
  - Use WordArt.
- Design a poster inviting all students of your university to the Computer Festival.
- Installation and demonstration of LaTeX.
- Prepare professional pdf documents using LaTeX.
- Prepare LaTex document containing mathematical equations.

COURSE OUTCOMES:

Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Ability to assemble and disassemble the PC components.	Under-stand	1	1
2	Installing Operating Systems and understanding the booting process.	Under-stand	1	1
3	Understand the basic concepts of web browsers, and internet services	Under-stand	1	1
4	Create word documents, presentations and spread sheets by applying various tools.	Create	2	2,5

TEXT BOOKS:

1. Anita Goel, "Computer Fundamentals", Pearson Education, 2017.
2. IBM PC and CLONES: "Hardware, Troubleshooting and Maintenance", B. Govindrajalu, Tata McGraw-Hill Publishers, 2002.

REFERENCES:

1. PritiSinha and Pradeep K. Sinha, "Computer Fundamentals: Concepts, Systems and Applications", 8th edition, BPB Publications, 2004.
2. Essential Computer and IT Fundamentals for Engineering and Science Students,
3. Stefan Kottwitz, "LaTeX Beginner's Guide: Create visually appealing texts, articles, and books for business and science using LaTeX", 2nd Edition, Kindle, 2021.
4. Stephen J Bigelow, "Troubleshooting, Maintaining and Repairing PCs", Tata McGraw Hill Publication, 5th Edition, 2001.
5. V. K mehta and Rohit mehta "Principles of Power System", 1st Edition, S. Chand, 2005.

22TP103 PROGRAMMING IN C

Techgig.com

Hours Per Week :

L	T	P	C
2	0	4	4

PREREQUISITE KNOWLEDGE: Fundamentals of Problem Solving.

COURSE DESCRIPTION AND OBJECTIVES:

This course is aimed to impart knowledge on basic concepts of C programming language and problem solving through programming. It covers basic structure of C program, data types, operators, decision making statements, loops, functions, strings, pointers, and also file manipulations. At the end of this course, students will be able to design, implement, test and debug complex problems using features of C.

MODULE- 1

UNIT-1 **8L+0T+16P=24 Hours**

INTRODUCTION TO ALGORITHMS AND PROGRAMMING LANGUAGES:

Introduction to Algorithms: Basics of algorithms; Flow charts; Generations of programming languages. Introduction to C: Structure of a C program - pre-processor statement, inline comments, variable declaration statements, executable statements; C Tokens - C character set, identifiers and keywords, type qualifiers, type modifiers, variables, constants, punctuations and operators.

Data Types and Operators: Basic data types; Storage classes; Scope of a variable; Formatted I/O; Reading and writing characters; Operators - assignment, arithmetic, relational, logical, bitwise, ternary, address, indirection, size of, dot, arrow, parentheses operators; Expressions - operator precedence, associative rules.

Control Statements: Introduction to category of control statements; Conditional branching statements - if, if– else, nested-if, if – else ladder, switch case; Iterative statements - for, while, do - while, nested loops; Jump statements - break, jump, goto and continue.

UNIT-2 **8L+0T+16P=24 Hours**

ARRAYS & STRINGS:

Arrays: Introduction; Types of arrays; Single dimensional array - declaration, initialization, usage, reading, writing, accessing, memory representation, operations; Multidimensional arrays.

Strings: Character array, Reading string from the standard input device, Displaying strings on the standard output device, Importance of terminating a string, Standard string library functions.

PRACTICES:

Questions on Data Handling – Level 1:

- Write a program to accept a character as input from the user and print it.
- Write a program to accept a number as input from the user and print it.
- Write a program to accept a float value from the user and print it.
- Write a program to accept a message as input from the user and print it.
- Write a program to accept a message from the user as input and print it in 3 different lines.
- Write a program to accept 2 numbers from the user as input and print their sum.
- Write a program to accept 2 numbers from the user as input and print their product.
- Write a program to accept a number as input from the user which denotes the temperature in Celsius, convert it to Fahrenheit reading and print it.

SKILLS:

- ✓ *Analysis of the problem to be solved.*
- ✓ *Select static or dynamic data structures for a given problem and manipulation of data items.*
- ✓ *Application of various file operations effectively in solving real world problems.*
- ✓ *Develop C programs that are understandable, debuggable, maintainable and more likely to work correctly in the first attempt.*

- Write a program to accept a number as input from the user which denotes the radius and print the area of the circle.
- Write a program to accept a character as input from the user and print it's corresponding ASCII value.

Questions on Control Statements - Looping – Level 1:

- Write a C program to print all the characters from a to z once.
- Write a C program to print all the characters from Z to A once.
- Write a C program to print all the characters from A to Z 3 times.
- Write a C program to print the first N natural numbers, where N is given as input by the user.
- Write a C program to print the first N natural numbers and their sum, where N is given as input by the user.
- Write a C program to print all the odd numbers between 1 and N where N is given as input by the user.
- Write a C program to print all the even numbers between I and N where N is given as input by the user.
- Write a C program to print the squares of the first N natural numbers between 1 and N, where N is given as input by the user.
- Write a C program to print the cubes of the first N natural numbers between 1 and N, where N is given as input by the user.
- Write a C program to print the squares of every 5th number starting from 1 to N, where N is given as input by the user.

Questions on Control Statements – Decision Making – Level 1:

- Write a program to accept two numbers as input check if they are equal.
- Write a program to accept two characters as input and check if they are equal.
- Write a program to accept two numbers as input and print the greater of the 2 numbers.
- Write a program to accept two numbers as input and print the lesser of the 2 numbers.
- Write a program to accept 3 numbers as input and print the maximum of the 3.
- Write a program to accept 3 numbers as input and print the minimum of the 3.
- Write a program to accept a number as input and print EVEN if it is an even number and ODD if it is an odd number.
- Write a program to accept a number as input and check if it is divisible by 3. If it is divisible by 3 print YES else print NO.
- Write a program to accept a number as input and check if it is divisible by both 3 & 5. If it is divisible print YES else print NO.
- Write a program to accept a number as input and check if it is positive, negative or zero.

Questions on Patterns – Level 1:

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

  *****

  *****

  *****

  *****

  *****

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

  *****

  * *

  * *

  * *

  *****

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
*
**
***
****
*****
```

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
    *
   **
  ***
 ****
*****
```

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
1
12
123
1234
12345
```

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
1
22
333
4444
55555
```

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
54321
4321
321
21
1
```

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
12345
2345
345
45
5
```

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
A
AB
ABC
ABCD
ABCDE
```

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

  A

  BC

  DEF

  GHIJ

  KLMNO

Questions on Number Crunching – Level 1:

- Write a program to accept a number as input and print the number of digits in the number.
- Write a program to accept a number as input print the sum of its digits.
- Write a program to accept a number as input, reverse the number and print it.
- Write a program to accept a number and digit as input and find the number of occurrences of the digit in the number.
- Write a program to accept a number as input and check if it is an Armstrong number.
- Write a program to accept a number as input and check if it is an Adam number.
- Write a program to accept a number as input and check if is a prime number.
- Write a program to accept 2 numbers as input and check if they are amicable or not.
- Write a program to accept a number as input and check if it is a power of 2.
- Write a program to accept 2 numbers as input and find their LCM.

Questions on Arrays – Level 1:

- Print the contents of an array from the left to the right.
- Print the contents of an array from the right to the left.
- Find the sum of the elements of an array.
- Find the maximum element in an unsorted array.
- Find the minimum element in an unsorted array.
- Find the average of the elements in an unsorted array.
- Count the number of 0s and 1s in an array having 0s and 1s in random order.
- Count the number of elements in an array whose elements are lesser than a key element in an unsorted array.
- Print all the elements in an array whose values are lesser than a key element in an unsorted array.
- Find the repeated elements in a sorted array.

Questions Number crunching – Level 2:

- Write a program to accept a number as input and print the product of its digits.
- Write a program to accept a number as input and check if it is a palindrome.
- Write a program to accept a number as input and print the frequency of occurrence of each digit.
- Write a program to accept a number as input and print its factors.
- Write a program to accept a number as input and print its prime factors.
- Write a program to accept a number as input and check if it is a perfect square of not.
- Write a program to accept 2 numbers as input and check if they are betrothed numbers or not.
- Write a program to accept 2 numbers as input and print their HCF.
- Write a program to accept a number as input and check if is a strong number.
- Write a program to generate prime numbers between two intervals given as input.

Questions on Arrays – Level 2:

- Find the sum of the maximum and minimum numbers of an unsorted array.
- Replace every element in an array with the sum of its every other element.
- Replace every element in an array with the sum of its right side elements.
- Replace every element in an array with the sum of its left side elements.
- Reverse the elements of an array (in place replacement).
- Reverse the first half of an array.

- Reverse the second half of an array.
- Write a program to find the second largest element in an unsorted array.
- Write a program to find the second smallest element in an unsorted array.
- Write a program to print the number of odd and even numbers in an unsorted array.

Questions on Strings – Level 1:

- Write a program to accept a string as input and print it.
- Write a program to accept a string as input and count the number of vowels in it.
- Write a program to accept a string as input and count the number of consonants in it.
- Write a program to accept a string as input and print its length.
- Write a program to accept a string as input and print the reversed string.
- Write a program to accept 2 strings as input and check if they are the same.
- Write a program to accept a string as input and copy the contents into a second string and print the second string.
- Write a program to accept 2 strings as input and concatenate them into a third string and print the third string.
- Write a program to accept a string as input and check if it is a palindrome.
- Write a program to accept two strings as input and check if the second string is a substring of the first.

Questions on Strings – Level 2:

- Implement the string length function.
- Implement the string copy function.
- Implement the string concatenate function.
- Implement the string compare function.
- Implement the vowel count function.
- Implement the consonant count function.
- Implement the count words function.
- Implement the string reverse function.
- Implement the strstr function.
- Complete the code snippet to implement the is Palindrome function that checks if a given string is a palindrome. You will need to use the 3 functions string Copy, str Reverse and string Compare functions provided to accomplish this.

MODULE-2

UNIT-1 **8L+0T+16P=24 Hours**

FUNCTIONS & POINTERS:

User-defined functions: Function declaration - definition, header of a function, body of a function, function invocation; Call by value; Call by address; Passing arrays to functions; Command line arguments; Recursion; Library Functions.

Pointers: Declaration, Initialization, Multiple indirection, Pointer arithmetic, Relationship between arrays and pointers, Scaling up - array of arrays, array of pointers, pointer to a pointer and pointer to an array; Dynamic memory allocation functions.

UNIT- 2 **8L+0T+16P=24 Hours**

STRUCTURES, UNIONS & FILES:

Structures: Defining a structure, Declaring structure variable, Operations on structures, Pointers to structure - declaring pointer to a structure, accessing structure members using pointer; Array of structures, Nested structures, Passing structures to functions - passing each member of a structure as a separate argument, passing structure variable by value, passing structure variable by reference/ address; Typedef and structures.

Unions: Defining a union - declaring union variable, operations on union; Pointers to union - declaring pointer to a union, accessing union members using pointer; Array of union, Nested union, Typedef and union, Enumerations, Bit-fields.

Files: Introduction to files, Streams, I/O using streams – opening a stream, closing stream; Character input, Character output, File position indicator, End of file and errors, Line input and line output, Formatted I/O, Block input and output, File type, Files and command line arguments.

PRACTICES:

Questions on Strings – Level 3:

- Write a program to swap two given strings and print the swapped strings.
- Write a program to swap two given words of the given sentence and print the altered string.
- Return the maximum occurring character in the string.
- Write a program to print the character in the string with the count where count is the occurrence of the character.
- Write a program to print the duplicate characters in the given string.
- Write a program to remove the duplicate characters in the given string.
- Write a program to remove the vowels from a given string.
- Write a program to rotate a given string N number of times.
- Write a program to check if 2 strings are rotations of each other.
- Write a program to remove the characters from the first string that are present in the second string.

Questions on 2D Arrays – Level 1:

- Print the contents of a 2D array row-wise.
- Print the contents of a 2D array column-wise.
- Print the contents of a 2D array in a zig-zag order.
- Print the contents of a 2D array diagonal-wise.
- Print the contents of a 2D array right-diagonal order.
- Print the contents of a 2D array left-diagonal order.
- Print the contents of a 2D array in the upper triangular order – left top to right bottom.
- Print the contents of a 2D array in the lower triangular order.
- Find and print the maximum element along with its position in a matrix.
- Find and print the minimum element along with its position in a matrix.

Questions on 2D Arrays – Level 2:

- Find and print the maximum element of each row of a matrix.
- Find and print the minimum elements of each row of a matrix.
- Find and print the maximum element of each column of a matrix.
- Find and print the minimum element of each column of a matrix.
- Find the lowest value in the upper triangle area and the largest value in the lower triangular area of a matrix and print their product.
- Find the sum of the elements of each row and each column of a matrix and print the minimum row sum and maximum sum column.
- Write a program to find the row with the maximum number of 1’s in a matrix consisting of only 0’s and 1’s.
- Write a program to print the quotient and remainder on dividing sum of left-top to right-bottom diagonal by sum of right-top to left-bottom diagonal.
- Write a program to print the absolute difference of the sum of major diagonal elements and the sum of minor diagonals of the given matrix.
- Write a program to search a given element in a row-wise and column-wise sorted 2D array.

Questions on 2D Arrays – Level 3:

- Write a program to find the Kth smallest element in the given matrix.
- Write a program to find the Kth largest element in the given matrix.

- Write a program to check whether the given two two-dimensional array of same dimensions are equal or not.
- Write a program to add the given two two-dimensional array of same dimensions.
- Write a program to subtract the given two two-dimensional array of same dimensions.
- Write a program to multiply the given two two-dimensional array of same dimensions.
- Write a program to sort each row of a matrix.
- Write a program to find the sum of the elements in 'Z' sequence of the given 2D array.
- Write a program to print the unique rows of the given two-dimensional array consisting of only 0's and 1's.
- Write a program to print the unique columns of the given two-dimensional array consisting of only 0's and 1's.

Questions on Files, Structures & Unions:

- Write a C program to create a struct, named Student, representing the student's details as follows: first_name, last_name, Age and standard.

  Example

  Read student data

  john

  carmack

  15

  10

  Display the data in the following format

  First Name: john

  Last Name: carmack

  Age: 15

  Standard: 10

- Declare a structure POINT. Input the coordinates of point variable and write a C program to determine the quadrant in which it lies. The following table can be used to determine the quadrant.

Quadrant	X	Y
1	Positive	Positive
2	Negative	Positive
3	Negative	Negative
4	Positive	Negative

  Example

  Input the values for X and Y coordinate: 7 9

  The coordinate point (7,9) lies in the First quadrant.

- Bob and Alice both are friends. Bob asked Alice how to store the information of the books using Structures. Then Alice written a c program to store the information of books using book structure by taking different attributes like book_name, author, book_id, price. Write a C program to read and display the attributes of the books using structures.

  Sample Input:

  Enter number of books: 1

  Enter the book name: c Programming

  Enter the author name: balaguruswamy

  Enter the book ID: 23413

  Enter the book price: 500

  Sample Output:

  The details of the book are:

  The book name is: c Programming

The author name is: balaguruswamy

The book ID is: 23413

The book price is: 500.00

- Ramesh wants to do addition on complex numbers. He did it with regular practice but Charan asked him to do with the help of structures by following below Criteria.

  Write a C program that defines a structure named 'Complex' consisting of two floating point members called "real and imaginary". Let c1 and c2 are two Complex variables; compute the sum of two variables.

  Example:

  c1= 2 8
  c2= 6 4
  Sum= 8.000000+12.000000i

- Customer Payment Details is a structure with members as customers_name, address, account_number, payment_status(paid(1)/ not_paid(0)), due_date, and amount. In this example, payment_date is another structure with month, day and year as integer members. So, every customer record can be considered as an array of structures.

  Write a C program that displays the amount to be paid by each customer along with their names. If payment_status is 1, display NIL for such customers.

  Input Format:

  First line of input contains 'n' number of customers, followed by 8 lines of input for each customer. Each line represents (customers_name, address, account_number, amount payment_status(paid(1)/ not_paid(0)), and due_date).

  Output Format:

  First line of output is Amount to be paid by each customer as on date: followed by n lines of output. Each line contains name of the customer followed by tab space, and amount to be paid.

  Hint: Use nested structure to represent date.

  Write a 'C' program to accept customer details such as: Account_no, Name, Balance using structure. Assume 3 customers in the bank. Write a function to print the account no. and name of each customer whose balance < 100 Rs.

- Write a C program to accept details of 'n' employee(eno, ename, salary) and display the details of employee having highest salary. Use array of structure.
- Write a C program to print the bill details of 'N' number of customers with the following data: meter number, customer name, no of units consumed, bill date, last date to deposit and city. The bill is to be calculated according to the following conditions:

No. of units	**Charges**
For first 100 units	Rs.0.75 per unit
For the next 200 units	Rs.1.80 per unit
For the next 200 units	Rs.2.75 per unit

  Sample Input

  Enter no. of customers

  1

  Enter Meter Number AP01213

  Enter Customer Name: Karthik

  Enter No. of units consumed: 200

  Enter Bill date:22/01/2021

  Enter Last date: 12/2/2021

  Enter City: Guntur

  Sample Output

  Meter Number AP01213

  Customer Name: Karthik

No. of units consumed: 200

Bill date:22/01/2021

Last date: 12/2/2021

City: Guntur

Total Amount: 255.000000

- Write a C program that creates a student file containing {Roll No, Student Name, Address, Stream}, where the data will be inserted and display the list of students who are in CSE (Stream=CSE).

  Input: A file name

  Output: The attributes such as Roll_No, Student_Name, Stream, Address.

  Sample Input

201fa4200	Raja	CSE	Guntur
201fa4201	Bala	IT	Tenali

  Sample Output

201fa4200	Raja	CSE	Guntur

- Write a C program that reads content from an existing text file and write the same in a new file by changing all lowercase alphabetic character to upper case. (Existing file may contain digit and special characters).

  Example:

  Input: Enter the file name.

  Output: New file with updated content.

- Write a C program to count the occurrences of the given string in a file.

  Example:

  Input: Enter the File name to read the string to be counted.

  Output: Display the count of occurrences of the string.

- Write a C Program to transfer the data from one location to another location without changing the order of the content.

  Example:

  Read the file name from the user. If the source file exists, Transfer the data and display the message as “Data is transferred successfully” otherwise display the message “No such file is existing in the directory.”

- Write a C program that reads numbers and write them into a text-file. Also find odd and even numbers in that file and store it in 2 separate files named odd.txt and even.txt. All the values should be in ascending order.

  Input: Enter the values.

  Output: Creates a separate file for Even and Odd numbers.

  Sample Input:

  4 43 2 53 45

  Sample Output:

  Even.txt: 2 4

  Odd.txt: 43 45 53

- Write a C program to replace the content in the given text file.

  Input: Enter the file name, line number to be replaced and the new content

  Output: New file with replaced lines.

  Example:

  Sample Input: Enter the file name: abc.txt

  Enter the line no to replace: 3

  Enter the content: Files stores data presently.

Sample Output:

Line no 3 is replaced with the given content.

The content of the file abc.txt contains:

test line 1

test line 2

Files stores data presently

test line 4

COURSE OUTCOMES:

Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Identify suitable data type for operands and design of expressions having right precedence.	Apply	1,2	1
2	Apply decision making and iterative features of C Programming language effectively.	Apply	1,2	1
3	Select problem specific data structures and suitable accessing methods.	Analyze	1,2	1,2
4	Develop C programs that are understandable, debuggable, maintainable and more likely to work correctly in the first attempt.	Evaluate	1,2	3,4
5	Design and develop non- recursive and recursive functions and their usage to build large modular programs and also able to design string manipulation functions.	Create	1,2	3

TEXT BOOKS:

1. Behrouz A. Forouzan, Richard F.Gilberg, “Programming for Problem Solving”, 1st edition, Cengage publications, 2019.
2. Ajay Mittal, “Programming in C - A Practical Approach”, 1st edition, Pearson Education, India, 2010.

REFERENCE BOOKS:

1. Reema Thareja, “Computer Fundamentals and Programming in C”, 1st edition, Oxford University Press, India, 2013.
2. Herbert Schildt, “C: The Complete Reference”, 4th edition, Tata McGraw-Hill, 2017.
3. Byron S Gottfried, “Programming with C”, 4th edition, Tata McGraw-Hill, 2018.

22EN102 ENGLISH PROFICIENCY AND COMMUNICATION SKILLS

Hours Per Week :

L	T	P	C
0	0	2	1

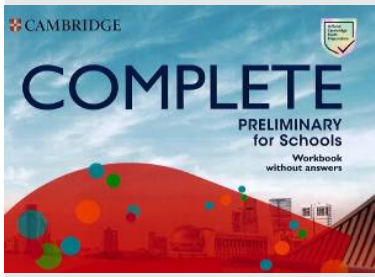


Image source: https://www.scribd.com/document/502301821/Cambridge-Complete-B1-Preliminary-for-Schools-Workbook-2020-Edition

PREREQUISITE KNOWLEDGE: Basics of grammar, Read and understand for global context, Cultural sensitivity and Basic writing skills.

COURSE DESCRIPTION AND OBJECTIVES:

English Proficiency and Communication Skills seeks to develop the students' abilities in grammar, speaking, reading, writing and overall comprehension skills. The course will provide students an exposure on a wide range of language use in everyday situations. It will make the students to equip with functional English and make them use it confidently in their professional and social contexts. Finally, students will strengthen their reading, writing, listening and speaking skills in English

MODULE-1

UNIT-1 **0L+0T+8P=8 Hours**

MY LIFE AND HOME – MAKING CHOICES – HAVING FUN:

Reading: Understanding main message, factual information global meaning, specific information and paraphrasing.
Writing: Developing hints based mail, Writing short messages/paragraphs.
Listening: Understanding short monologues or dialogues and choose the correct visual.
Speaking: Express simple opinions /cultural matters in a limited way.
Vocabulary: Discerning use of right word suiting the context, B1 Preliminary word list.
Grammar: Frequency Adverbs, State Verbs, AFV and Prepositions.

UNIT-2 **0L+0T+8P=8 Hours**

ON HOLIDAY - DIFFERENT FEELINGS – THAT'S ENTERTAINMENT!:

Reading: Longer text for detailed comprehension, gist and inference.
Writing: Developing notes and responding to penfriends or 'e-pals'.
Listening: Understand straightforward instructions or public announcements.
Speaking: Describing people, things and places in a photograph.
Vocabulary/Grammar:
Comparatives and Superlatives, Gradable and non-gradable adjectives, Cloze tests.

PRACTICES:

- Developing hints based mail.
- Writing short message.
- Writing paragraphs.
- Expressing opinions and cultural matters.
- Understanding short monologues.
- Understanding straightforward instructions and public announcements.
- Describing people, things and places in a photograph.

MODULE-2

UNIT-1 **0L+0T+8P=8 Hours**

GETTING AROUND – INFLUENCES - STAY FIT AND HEALTHY:

Reading: Reading for understanding coherence of the text and drawing inferences.
Writing: Reading an announcement from a magazine or website for preparing an article.

SKILLS:

- ✓ *Use of appropriate grammar and vocabulary with syntactic patterns in short texts.*
- ✓ *Read and extract the main message, global meaning, specific information, detailed comprehension, understanding of attitude, opinion and writer purpose and inference.*
- ✓ *Listen to understand key information, specific information, gist and detailed meaning and to interpret meaning.*
- ✓ *Understand questions and make appropriate responses and talk freely on everyday topics.*

Listening: Discussion activities and listening to understand the gist of each short dialogue.

Speaking: Snap Talks, Make and respond to suggestions, discuss alternatives and negotiate agreement.

Vocabulary / Grammar: Punctuation, Prepositions, Phrasal Verbs, B1 Preliminary word list.

UNIT-2 **0L+0T+8P=8 Hours**

LOOKS AMAZING! – THE NATURAL WORLD – EXPRESS YOURSELF!:

Reading: Content, Communicative Achievement, Organisation and Language.

Writing: Developing a story with clear links to the given opening sentence.

Listening: An interview for a detailed understanding of meaning and to identify attitudes and opinions.

Speaking: Discuss likes, dislikes, experiences, opinions, habits, etc.

Vocabulary/Grammar: Modals, Conditionals, Verb forms (Time and Tense).

PRACTICES:

- Listening to understand the gist of each short dialogue.
- Listening to an interview for a detailed understanding of meaning and to identify attitudes and opinions.
- Preparing an article.
- Discuss for alternatives and negotiate agreement.
- Discussion on likes, dislikes, experiences, opinions, habits, etc.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply to read and grasp content on a range of topics/ texts related to their everyday life like notifications, advertisements, travel brochures, news reports, articles.	Apply	1	7, 8, 9, 10, 12
2	Apply suitable strategies to achieve comprehension, like listening for main points and checking comprehension using contextual clues etc.	Apply	1	7, 8, 9, 10, 12
3	Demonstrate vocabulary beyond that of the familiar subjects.	Analyze	1, 2	7, 8, 9, 10, 12
4	Show sufficient control of English grammar and sentence variety to coherently organise information at sentence and discourse levels.	Evaluate	2	7, 8, 9, 10, 12
5	Use functional English to communicate and interact effectively in everyday situations.	Create	2	7, 8, 9, 10, 12

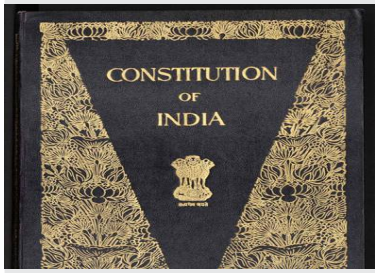
TEXT BOOKS:

1. Emma Heyderman and Peter May, “Complete Preliminary”, Student’s Book with Answers, 2nd edition, Cambridge University Press, 2019.

REFERENCE BOOKS:

1. Annette Capel and Rosemary Nixon, “Introduction to PET”, Oxford University Press, 2009.
2. Adrian Doff and Craig Thaine, “Empower Pre intermediate”, Cambridge University Press, 2015.
3. Louise Hashemi and Barbara Thomas, “Objective PET”, Cambridge University Press, 2010.

22TP101 CONSTITUTION OF INDIA



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Hours Per Week :

L	T	P	C
0	2	0	1

PREREQUISITE KNOWLEDGE: High School-level Civics and Social Studies.

COURSE DESCRIPTION AND OBJECTIVES:

To provide students with a basic understanding of Indian Polity and Constitution and make students understand the functioning of government at the center and state level besides local self-government. This course also equips students with knowledge pertaining to fundamental rights and fundamental duties of a citizen in a democracy such as India.

MODULE-1

UNIT-1 **0L+8T+0P=8 Hours**

HISTORICAL BACKGROUND TO THE INDIAN CONSTITUTION:

Meaning of the constitution law and constitutionalism; Historical perspective of the Constitution of India; Salient features and characteristics of the Constitution of India.

UNIT-2 **0L+8T+0P=8 Hours**

FUNDAMENTAL RIGHTS, DUTIES, DIRECTIVE PRINCIPLES, AND AMENDMENT:

Scheme of the fundamental rights - scheme of the Fundamental Right to Equality; scheme of the Fundamental Right to certain Freedom under Article 19; scope of the Right to Life and Personal Liberty under Article 21; Scheme of the Fundamental Duties and its legal status; Directive Principles of State Policy – its importance and implementation; Amendment of the Constitution - Powers and Procedure.

PRACTICES:

- Enactment of Constituent Assembly debates to further understand the rationale for the provisions of the constitution.
- Fundamental Rights in our popular culture - discussion in the movie Jai Bhim.

MODULE-2

UNIT-1 **0L+8T+0P=8 Hours**

STRUCTURE AND FORM OF GOVERNMENT:

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; Emergency Provisions: National Emergency, President Rule, Financial Emergency.

UNIT-2 **0L+8T+0P=8 Hours**

LOCAL SELF GOVERNMENT:

Local Self Government – Constitutional Scheme in India – 73rd and 74th Amendments.

PRACTICES:

- Debate on federalism in India.
- Collect news published in the local papers about panchayats in the nearby areas.

SKILLS:

- ✓ *Understanding the basics of the Indian constitution.*
- ✓ *Know the fundamental rights, fundamental duties, and Directive Principles of State Policy.*
- ✓ *Fair knowledge about the functioning of various institutions in a democracy.*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyse major articles and provisions of the Indian constitution.	Analyze	1	6
2	Appreciation for the constitution and safeguarding individual rights.	Apply	1	6
3	Evaluating functions of various organs of the State in a democracy.	Evaluate	2	6

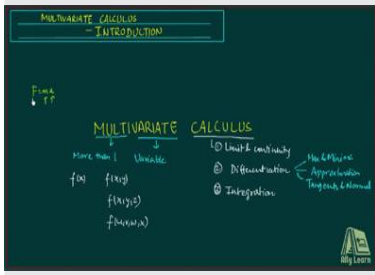
TEXTBOOK:

1. PM Bhakshi, “Constitution of India”, 15th edition, Universal Law Publishing, 2018.

REFERENCE BOOKS:

1. B. R. Ambedkar, “The Constitution of India” Educreation Publishing, India, 2020.
2. Subhash Kashyap, “Our Constitution” 2nd edition, National Book Trust, India, 2011.
3. Arun K. Thiruvengadam, “The Constitution of India: A Contextual Analysis”, Hart Publishing India, 2017.

22MT110 MATRICES AND DIFFERENTIAL EQUATIONS



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Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: School level Mathematics, Differentiation and Integration.

COURSE DESCRIPTION AND OBJECTIVES:

This course will help the students to learn the concepts of matrices and differential equations. Also they can apply these concepts in any engineering and science domains.

MODULE-1

UNIT-1 **12L+8T+0P=20 Hours**

MATRICES:

Definition of matrix; Types of matrices; Algebra of matrices, adjoint of a matrix, inverse of a matrix by elementary operations, Rank of a matrix, Echelon form, Normal form.

UNIT-2 **12L+8T+0P=20 Hours**

APPLICATIONS OF MATRICES:

Consistency of system of linear equations, Solution of system of linear equations by Gauss elimination method and Gauss Jordan method.

Eigen values and Eigen vectors (up to 3 x 3 matrices only) and properties (without proofs).

PRACTICES:

- Identify the matrix and do various operations on it.
- Finding rank of matrix.
- Solving a system of equation using matrix method
- Find Eigen values and Eigen vectors.

MODULE-2

UNIT-1 **12L+8T+0P=20 Hours**

ORDINARY DIFFERENTIAL EQUATIONS:

First Order Differential Equations: Introduction to ODE, variable separable method, homogenous and non-homogenous differential equations, linear differential equations, Bernoulli's equations.

Second Order Differential Equations: Linear Homogeneous and non-homogeneous differential equations with constant coefficients (RHS is eax, xn, sin(ax) or cos(ax)).

UNIT-2 **12L+8T+0P=20 Hours**

APPLICATIONS OF ODE:

Applications of ODE: Newton's law of cooling, Law of natural growth and decay, LC circuit.

PRACTICES:

- Finding Solutions of Differential Equations.
- Apply the concepts of Differential equations.

COURSEOUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply elementary transformations to find the rank and inverse.	Apply	1	1, 2, 9, 10, 12
2	Solve the Ordinary differential equations.	Apply	2	1, 2, 9, 10, 12
3	Apply the differential equation in various problems.	Apply	2	1, 2, 9, 10, 12
4	Examine the consistency of the system of linear equations.	Analyse	1	1, 2, 9, 10, 12

TEXT BOOKS:

1. N. P. Bali, K. L. Sai Prasad, “A Textbook of Engineering Mathematics I, II, III”, 2nd Edition, Universal Science Press, New Delhi, 2018.
2. B. S. Grewal, “Higher Engineering Mathematics”, 44th Edition, Khanna Publishers, 2018.

REFERENCE BOOKS:

1. Erwin Kreyszig, “Advanced Engineering Mathematics”, 10th Edition, John Wiley & Sons, Inc., 2015
2. H. K. Dass and Er. Rajanish Verma, “Higher Engineering Mathematics”, Third revised edition, S. Chand & Co., 2015.
3. B. V. Ramana, “Advanced Engineering Mathematics”, TMH Publishers, 2020.

22ME101 ENGINEERING GRAPHICS

Image source: https://depositphotos.com/5087383/stock-photo-the-engineering-drawing.html
Image file name: Engineering Graphics

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Basics of Geometry

COURSE DESCRIPTION AND OBJECTIVES:

Engineering graphics is the language of engineers and is the most effective way of communicating and sharing technical ideas in the form of pictures/drawings. The objective of this course is to familiarize the students with the conventional concepts of engineering drawing and computer aided drawing.

MODULE-1

UNIT-1 **6L+0T+6P=12 Hours**

ENGINEERING CURVES:

Types of lines; Lettering, Dimensioning, Geometric constructions - lines, polygons (Angle, ARC, General and Inscribe in circle method), Conical curves (General method), Ellipse by Oblong method.

UNIT-2 **10L+0T+10P=20 Hours**

ORTHOGRAPHIC PROJECTIONS OF POINTS, LINES & PLANES:

Principles of projection; Projections of points; Projection of straight lines - Inclined to one plane, inclined to both planes; Projection of planes - Inclined to one plane.

PRACTICES:

- Construction of polygons using different methods (i.e. ARC, Angle, General).
- Inscribe a regular hexagon & pentagon in a circle of the given diameter.
- Tracing of conical curves (Ellipse, Parabola, Hyperbola) by using General Method.
- Draw the projections of the points situated in all the 4 quadrants.
- Draw the projections of a line when it is inclined to one plane (HP or VP).
- Draw the projections of a line when it is inclined to both the planes (HP &VP).
- Draw the projections of a plane when it is inclined to one plane (HP or VP).

MODULE-2

UNIT-1 **6L+0T+6P=12 Hours**

PROJECTIONS OF SOLIDS AND DEVELOPMENT OF SURFACES:

Projections of Solids: Projection of solids axis inclined to one reference plane - Prisms, pyramids, Cylinder and cone.

Development of Surfaces: Development of lateral surfaces of simple solids - Prisms, Pyramids, Cylinder and cone.

UNIT-2 **10L+0T+10P=20 Hours**

ORTHOGRAPHIC VIEWS AND DRAFTING USING COMPUTER PACKAGE:

Orthographic Views: Conversion of pictorial views into orthographic views.

Drafting Using Computer Package: Introduction to 2D modelling software - AutoCAD; Conversion of Isometric view into Orthographic views of simple castings; Conversion of Orthographic views into Isometric view of simple solids - Prisms, Pyramids, Cylinders and cones.

SKILLS:

- ✓ *Convert iso-metric views of objects into orthographic views and vice versa.*
- ✓ *Visualize the shape of the 3D components.*
- ✓ *Create pictorial views by using AutoCAD.*
- ✓ *Understand projections by visualization.*

PRACTICES:

- Draw the projections of Prisms, when they are inclined to one reference plane (HP or VP).
- Draw the projections of Pyramids, when they are inclined to one reference plane (HP or VP).
- Draw the projections of cylinder & cone, when they are inclined to one reference plane (HP or VP).
- Draw the complete surface development of prisms & pyramids with the given dimensions.
- Draw the complete surface development of cylinder & cone with the given dimensions.
- Draw the orthographic view's (i. e. front view, top view, and side view) of the given pictorial view of the sketches by using AutoCAD.
- Draw the Isometric view of simple solids (Prisms & Pyramids) by using AutoCAD.
- Draw the Isometric view of simple solids (Cylinder & Cone) by using AutoCAD.

COURSEOUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Communicate the technical ideas in the form of drawings.	Apply	1	1,2,3,5
2	Apply the drawing skills in representing various geometrical features.	Apply	1	1,2,3,5
3	Develop orthographic projections and isometric views of various objects.	Apply	1	1,2,3,5
4	Estimate the lateral surface area of regular geometrical solids.	Analyze	2	1,2,3,5
5	Sketch simple objects and their pictorial views using AutoCAD.	Analyze	2	1,2,3,5

TEXT BOOKS:

1. J Hole, "Engineering Drawing", 2nd edition, Tata McGraw-Hill, 2019.
2. N D Bhatt, "Engineering Drawing", 53rd edition, Charotar Publication, 2014.

REFERENCE BOOKS:

1. Basant Agrawal and C.M. Agrawal "Engineering Drawing", 2nd edition, Tata Mc Graw- Hill, 2018.
2. K L Narayana, "Engineering drawing", 3rd edition, SciTech Publications, 2011.
3. Colin H. Simmons, Dennis E. Maguire, Manual of Engineering Drawing, 2nd edition, 2003.

22TP104 BASIC CODING COMPETENCY

Source: https://www.geeksforgeeks.org/best-way-to-start-with-competitive-programming-geeksforgeeks-cp-live-course/

Hours Per Week :

L	T	P	C
0	1	3	2

PREREQUISITE KNOWLEDGE: Programming in C.

COURSE DESCRIPTION AND OBJECTIVES:

This course is aimed to impart knowledge on advanced concepts of C programming language and problem solving. At the end of this course, students will be able to design, implement, test and debug complex problems using features of C.

MODULE-1

UNIT-1 **0L+4T+12P=16 Hours**

NUMBER CRUNCHING :

PRACTICES:

Problems On Number Crunching

- Write a program to check if a given number is perfect or not.
- Write a program to check if a given number is deficient or not.
- Write a program to check if 2 given numbers are amicable or not.
- Write a program to check if 2 given numbers are betrothed or not.
- Write a program to check whether a given number is an Armstrong number or not.
- Write a program to print the series of prime numbers in the given range.
- Write a program to print all the perfect numbers in a given range.
- Write a program to generate all deficient numbers in a given range.
- Write a program to generate all the amicable numbers in a given range.
- Write a program to generate all the betrothed numbers in a given range.
- Write a program to find the largest prime factor of a given number.
- Write a program to check whether the given number is a palindrome or not.
- Write a program to calculate sum of the individual digits for the given number.
- Write a program to find the first number that has more than ‘n’ factors, excluding 1 and that number.
- Write a program to accept a number as input and print its factorial.
- Write a program to accept a number n, print first N Fibonacci numbers.
- Write a program to check if an input number is Armstrong number or not.
- Write a program that takes input a,b. Print a power b.
- Write a program that takes input a number n, check if it a perfect square or not.
- Print array in spiral format.
- Print sum of each row in a matrix.
- Print sum of each column in matrix.
- Print left->right and right->left diagonals in a matrix.
- Initially you are at (0,0) find the shortest path count to reach the (n, n) block in matrix.
- Remove all the elements present in row and column of unsafe elements. An element is called unsafe if it is equal to smallest or largest value. Count number of remaining elements.
- Write a program to check if the string contains all the letters of alphabet.

SKILLS:

- ✓ *Analysis of the problem to be solved.*
- ✓ *Application of various file operations effectively in solving real world problems.*
- ✓ *Develop C programs that are understandable, debuggable, maintainable and more likely to work correctly in the first attempt.*

- Check if a string is matching password requirements.
- Check if String A contains String B (String searching).
- Check if a number is harshad number or not.
- Write a program to get 3 numbers as input. The first is the number num1 and second is the digit that needs to be replaced. The third is the digit that is to replace the 2nd digit. Print the number after performing this operation.
- Write a program to accept a number and swap its alternate digits. Print the number generated.
- Write a program to accept a number and choice as input. If the choice is 0 rearrange the number such that the odd digits are ordered first followed by the even digits. If the choice is 1 rearrange the number such that the even digits are ordered first followed by the odd digits. Print the rearranged number. The order of occurrence of the digits is to be preserved.
- Write a program to determine that whether the given quadrilateral is cyclic or not. You are given the sizes of angles of a simple quadrilateral (in degrees) A, B, C and D, in some order along its perimeter.

  Note: A quadrilateral is cyclic if and only if the sum of opposite angles is 180^0.
- Chef is a very lazy person. Whatever work is supposed to be finished in x units of time, he finishes it in m*x units of time. But there is always a limit to laziness, so he delays the work by at max d units of time. Given x,m,d, find the maximum time taken by Chef to complete the work.
- Suppose Chef is stuck on an island and currently he has x units of food supply and y units of water supply in total that he could collect from the island. He needs xr units of food supply and yr units of water supply per day at the minimal to have sufficient energy to build a boat from the woods and also to live for another day. Assuming it takes exactly D days to build the boat and reach the shore, tell whether Chef has the sufficient amount of supplies to be able to reach the shore by building the boat? Read five integers x,y,xr,yr,D from the user and display “YES” if Chef can reach the shore by building the boat and “NO” if not (without quotes).
- There are 3 problems in a contest namely A,B,C respectively. Alice bets Bob that problem C is the hardest while Bob says that problem B will be the hardest.

  You are given three integers SA,SB,SC which denotes the number of successful submissions of the problems A,B,C respectively. It is guaranteed that each problem has a different number of submissions. Determine who wins the bet.

  1) If Alice wins the bet (i.e. problem C is the hardest), then output Alice.

  2) If Bob wins the bet (i.e. problem B is the hardest), then output Bob.

  3) If no one wins the bet (i.e. problem A is the hardest), then output Draw.

  Note: The hardest problem is the problem with the least number of successful submissions.

  Input Format

  - The first line of input contains a single integer T denoting the number of test cases. The description of T test cases follows.
  - The first and only line of each test case contains three space-separated integers SA,SB,SC, denoting the number of successful submissions of problems A,B,C respectively.

  Output Format

  For each test case, output the winner of the bet or print Draw in case no one wins the bet.

  Sample Input 1

  3

  1 4 2

  16 8 10

  14 15 9

  Sample Output 1

  Draw

  Bob

  Alice

- In a season, each player has three statistics: runs, wickets, and catches. Given the season stats of two players A and B, denoted by R, W, and C respectively, the person who is better than the other in the most statistics is regarded as the better overall player. Tell who is better amongst A and B. It is known that in each statistic, the players have different values.

  Input

  The first line contains an integer T, the number of test cases. Then the test cases follow.

  Each test case contains two lines of input.

  The first line contains three integers R1, W1, C1, the stats for player A.

  The second line contains three integers R2, W2, C2, the stats for player B.

  Output

  For each test case, output in a single line "A" (without quotes) if player A is better than player B and "B" (without quotes) otherwise.

- Write a program to find the direction.

  Chef is currently facing the north direction. Each second he rotates exactly 90 degrees in clockwise direction. Find the direction in which Chef is facing after exactly X seconds.

  Note: There are only 4 directions: North, East, South, West (in clockwise order). Initially chef is at 0th second i.e., facing North direction.

  Input Format

  - First line will contain T, number of testcases. Then the testcases follow.
  - Each testcase contains of a single integer X.

  Output Format

  For each testcase, output the direction in which Chef is facing after exactly X seconds.

  Sample Input 1

  3

  1

  3

  6

  Sample Output 1

  East

  West

  South

- Chef is playing in a T20 cricket match. In a match, Team A plays for 20 overs. In a single over, the team gets to play 6 times, and in each of these 6 tries, they can score a maximum of 6 runs. After Team A's 20 overs are finished, Team B similarly plays for 20 overs and tries to get a higher total score than the first team. The team with the higher total score at the end wins the match.

  Chef is in Team B. Team A has already played their 20 overs, and have gotten a score of R. Chef's Team B has started playing, and have already scored C runs in the first O overs. In the remaining 20−O overs, find whether it is possible for Chef's Team B to get a score high enough to win the game. That is, can their final score be strictly larger than R?

  Input: There is a single line of input, with three integers, R, O, C.

  Output: Output in a single line, the answer, which should be "YES" if it's possible for Chef's Team B to win the match and "NO" if not.

- Make Array Zeros using pointers

  You are given an array A of length N (size should be created using Dynamic memory allocation) and can perform the following operation on the array:

  Select a subarray from array A having the same value of elements and decrease the value of all the elements in that subarray by any positive integer x.

  Find the least possible number of operations required to make all the elements of array A equal to zero.

The first line contains an integer N denoting the number of elements in the array.

The next line contains space-separated integers denoting the elements of array A.

Print the least possible number of operations required to make all the elements of array A equal to zero.

Sample Test case

Input:

5

2 2 1 3 1

Output:

4

UNIT-2 **0L+4T+12P=16 Hours**

PATTERNS:

PRACTICES:

Problems on Number Patterns

- Write a program to generate Floyd triangle. Sample input N= 4.
  1
  2 3
  4 5 6
  7 8 9 10
- Write a program to generate the following pattern. Sample input N=5.
  13579
  3579
  579
  79
  9
- Write a program to generate the following pattern. Sample input N=4.
  1111111
  222222
  33333
  4444
  333
  22
  1
- Write a program to generate the following pattern. Sample input N=5.
  5432*
  543*1
  54*21
  5*321
  *4321
- Write a program to generate the following pattern. Sample input N=5.
  12 21
  123 321
  1234 4321
  123454321

- Write a program to generate the following pattern. Sample input N=5.

  1
  2*2
  3*3*3
  4*4*4*4
  4*4*4*4
  3*3*3
  2*2
  1
- Write a program to generate the following pattern. Sample input N=4.

  1
  212
  32123
  4321234
- Write a program to generate the following pattern. Sample input N=5.

  *
  * *
  * * * *
  * *
  *
- Write a program to print Pascal triangle for the given number of rows. Sample input N=5.

```
                1
            1       1
        1       2       1
    1       3       3       1
1       4       6       4       1
```

- Write a program to generate the following pattern. Sample input N=4.

  1234
  2341
  3421
  4321
- Print Hollow Diamond pattern.
- Print pascals triangle.
- Print Floyds triangle.
- Print Butterfly Pattern.
- Print palindromic pattern.
- Print full inverted number triangle.
- Check if a number is prime or not (Efficient Approach).
- Find sum of all the digits of the number.
- Print transpose of given matrix.
- Rotate a two dimensional matrix by 90, 180, 270 degrees.

MODULE-2

UNIT-1 **0L+4T+12P=16 Hours**

ARRAYS:

PRACTICES:

Problems On Arrays

- Given an unsorted array of size N, and the array elements are in the range of 1 to N. There are no duplicates, and the array is not sorted. One of the integers is missing. Write a program to find the missing number.
- Given an array consisting of only 0s and 1s in random order rearrange the array such that all the 0s are to the left of the array and 1s to the right.
- Give an array consisting of odd and even numbers in random order, rearrange the array such that all the odd numbers are to the left of the array and even numbers are to the right of the array.
- Write a program to find all the unique elements in an array.
- Write a program to merge two arrays of the same size sorted in descending order.
- Write a program to count the frequency of each element in an array of integers.
- Write a program to find the second largest element in an array.
- Write a program to find the second smallest element in an array.
- Write a program to find that one element in array that occurs odd number of times, where every other element appears even number of times.
- Create a jagged array (adjacency list representation of a graph) with no of rows and no of columns in each row as specified by the user.

  Hint: Use Dynamic memory allocation (malloc() or calloc())

  Input:

  Enter no of rows: 3

  Enter no of columns Row in 1: 3

  Enter no of columns Row in 2: 5

  Enter no of columns Row in 3: 2

  Enter the elements row wise:

  8 6 5

  8 4 6 9 7

  9 2

  Output:

  8 6 5

  8 4 6 9 7

  9 2
- Write a program to find second largest number in the array.
- Write a program to find first repeating element in the array.
- Write a program to left rotate the array.
- Write a program to right rotate the array.
- Write a program to find the largest continuous sum.
- Write a program to print the sum of 2nd largest and 2nd smallest elements.
- Write a program to find the maximum product of two numbers multiplies in array (same index should not be used twice).
- Rearrange an array consisting of 1s and 0s such that they are alternatively arranged. Print minimum number of moves required.
- In a given array, find two numbers whose sum equal k.
- Find the difference between positive and negative elements in the array.
- Implement sorting algorithms (Insertion, selection, bubble).

UNIT-2 **0L+4T+12P=16 Hours**

STRINGS:

PRACTICES:

Problems on Strings:

- Write a program to reverse a given string word by word.
- Write a program to find the first occurrence of non-repeating character in the given string.
- Write a program to compress the string as provided in the example.
- Write a program to expand a string as provided in the example.
- Write a program to reverse those words of a string whose length is odd.
- Write a program to check if a given matrix is symmetric or not.
- Write a program to convert all the cases of letter (Lower case -> Upper Case, Upper Case-> Lower Case).
- Write a program to reverse all the words (Not the entire sentence but individual words).
- Find the longest palindrome in a given string.
- Check if two strings are anagrams or not.
- Find minimum number of changes to be done to make a string palindrome.
- Convert Excel sheet name to number (A-1, B-2, Z-26, AA-27).
- Find number of possible palindromes present in a string.
- Write a C program to read a string s, and determine the number of words in s.

  Example : s=oneTwoThree

  There are 3 words in the string: ‘one’, ‘Two’, ‘Three’.
- Write a C program that reads a string S and remove all duplicates characters from the given string S.

  NOTE: 1) Order of characters in output string should be same as given in input string.

  2) String S contains only lowercase characters [‘a’-’z’].

  Example: S = Vignanuniversity

  The program should generate the output as: Vignauersty
- Today Ron is reading the book. Due to some reason, he started hating the word ‘are’ (without quotes). So he decided to replace the substring ‘are’ with ‘R’. Write a C program that reads a line of message ‘s’ and replace the substring ‘are’ with ‘R’. Example: s= Howareyou.

  The program should generate the output as: HowRyou
- Write a program to concatenate the characters of the two given strings alternatively.
- Given a string S consisting of uppercase and lowercase letters, change the case of each alphabet in this string. That is, all the uppercase letters should be converted to lowercase and all the lowercase letters should be converted to uppercase.

  Input: Vignan University

  Output: vIGNAN uNIVERSITY
- Write a program to insert a given character at the beginning and end of the given string.
- Given two Strings A and B. They are said to be friends if ASCII sum of the each individual string is divisible by 4 else they are not friends. You need to find whether given two strings are friends or not.

  Sample Test case:

  Input:

  man nam

  vignan university

  Output:

  YES

  NO

- Write a program to find the frequency of each digit in the given string.

  Input Format

  The first line contains a string, which is the given number.

  Output Format

  Print ten space-separated integers in a single line denoting the frequency of each digit, indicate that the integers are from 0 to 9.

  Sample Input 0

  a11472o5t6

  Sample Output 0

  0 2 1 0 1 1 1 1 0 0

  Explanation 0

  In the given string:

  · 1 occurs two times.
  · 2,4,5,6 and 7 occur one time each.
  · The remaining digits and don't occur at all.

- Sherlock considers a string to be valid if all characters in the given string appear the same number of times. It is also valid if he can remove just 1 character at 1 index in the string, and the remaining characters will occur the same number of times.

  Write a C program that reads a string s and determine whether it is valid or not. If valid, return YES, otherwise return NO.

  Example: S=abc
  This is a valid string because frequencies are {a:1,b:1,c:1}
  S=abcc
  This is a valid string because we can remove one c and have 1 of each character in the remaining string.
  S=abccc
  This string is not valid as we can only remove 1 occurrence of c. That leaves character frequencies of {a:1,b:1,c:2}

- Read a string containing characters A and B only. Your task is to change it into a string such that there are no matching adjacent characters. To do this, you are allowed to delete zero or more characters in the string.

  Write a C program that finds the minimum number of deletions required.

  Example: S=AABAAB

  Remove A at positions 0 and 3 to make S=ABABA in 2 deletions.

  Input Format

  The first line contains an integer (the number of queries).

  The next q lines each contain a string s to analyze.

  Sample Input:

  5

  AAAA

  BBBBB

  ABABABAB

  BABABA

  AAABBB

  Sample Output:

  3
  4
  0
  0
  4

- Write a C program that reads a string 's' and it is said to be complete if it contains all the characters from a to z.
  Input Format
  First line of the input contains the number of strings N. It is followed by N lines each contains a single string.
  Output Format
  For each test case print "YES" if the string is complete, else print "NO"
  Constraints 1 <= N <= 10
  The length of the string is at max 100 & the string contains only the characters a to z.
- Write a C program that reads two strings and determine whether they share a common substring or not. A substring may be as small as one character.
  Example;
  S1=and
  S2=art
  The common substring in these two strings: a.
  Sample Input
  2
  hello
  world
  hi
  world
  Sample Output
  YES
  NO

COURSE OUTCOMES:

Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Mod-ule No.	Mapping with POs
1	Write simple, but complete, C programs.	Apply	1,2	1
2	Identify suitable data type for operands and design of expressions having right precedence.	Apply	1,2	1
3	Apply decision making and iterative features of C Programming language effectively.	Apply	1,2	1
4	Select problem specific data structures and suitable accessing methods.	Analyze	1,2	1,2
5	Design and develop non- recursive and recursive functions and their usage to build large modular programs and also able to design string manipulation functions.	Create	1,2	3
6	Develop C programs that are understandable, debuggable, maintainable and more likely to work correctly in the first attempt.	Create	1,2	3,4

TEXT BOOKS:

1. Behrouz A. Forouzan, Richard F.Gilberg, "Programming for Problem Solving", 1st edition, Cengage publications, 2019.
2. Ajay Mittal, "Programming in C - A Practical Approach", 1st edition, Pearson Education, India, 2010.

REFERENCE BOOKS:

1. Reema Thareja, "Computer Fundamentals and Programming in C", 1st edition, Oxford University Press, India, 2013.
2. Herbert Schildt, "C: The Complete Reference", 4th edition, Tata McGraw-Hill, 2017.
3. Byron S Gottfried, "Programming with C", 4th edition, Tata McGraw-Hill, 2018.

Image source: https://www.abebooks.com/9781316640081/English-Technical-Communication-Students-Book-1316640086/plp

22EN104 TECHNICAL ENGLISH COMMUNICATION

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Basic sentence formation, understanding contextual meanings, basic writing skills and moderate fluency in English.

COURSE DESCRIPTION AND OBJECTIVES:

In this course students will read, analyze, and interpret material from technical and general fields, and practice reading, writing, listening and speaking skills to gain exposure and functional English on a variety of contemporary topics. The overall course objective is to provide English for Specific Purposes(ESP) instruction to enhance students' reading, writing, listening and speaking skills through a practice in the language. It will aim to build students' confidence and motivation through exposure to academic skills like Note making/taking, Paraphrasing, Summarizing, Report Writing, Making Presentations etc., so as to generate interest in the language from an ESP perspective. Finally, students are expected through the course to gain key strategies and expression for communicating with professionals and non-specialists.

MODULE-1

UNIT-1 **8L+0T+8P=16 Hours**

GENETICS:

Reading: Reading for Note Making Sub skills: Reading for global understanding (skimming), specific information (scanning), understanding main ideas and supporting ideas, guessing contextual meanings from the text. -Vocabulary building: commonly used roots, prefixes, and suffixes.

Writing: Note making, organising main points and sub points, numbering and sequencing, suggesting titles, paraphrasing and summarising.

Functional grammar: Common Errors in Articles and Prepositions (Handout).

Listening: Listening for Note Taking: top down and bottom up approach, listening for main ideas and supporting points.

Speaking: Presentation in teams - ideas on the topic summarised, making a PPT, effective introductions and conclusions, logical organisation of content, using appropriate structure and cohesive devices.

UNIT-2 **8L+0T+8P=16 Hours**

ALIENS:

Reading : Predicting, skimming, scanning, reading for inference, extrapolative reading

Vocabulary building: Academic vocabulary from the text: synonyms, antonyms, Words often confused.

Writing : Paragraph writing; writing a topic sentence, supporting sentences, effective introductions and conclusions, use of cohesive devices. Types of Paragraphs: Descriptive, narrative, argumentative and expository.

Functional grammar: Common Errors in Verb forms and Conditional sentences (Handout).

Listening : Listening for identifying parts from a description, listening to and sorting information, listening for specific information.

Speaking : Narrating/Retelling an incident, using suitable cohesive devices/discourse markers Speaking of past and present habits/ activities/events - Speaking of future plans.

PRACTICES:

- Note making.
- Summarizing.
- Paragraph Writing.
- Error correction and Restructuring.
- Vocabulary building.
- Listening comprehension.
- Note taking.

SKILLS:

- ✓ *Apply different sub skills like skimming, scanning, reading for information, reading for inference etc. to understand different kinds of text.*
- ✓ *Apply different sub skills like top down, bottom up approaches to listening.*
- ✓ *Use functional vocabulary relevant to engineering and technology to express ideas lucidly.*
- ✓ *Use appropriate sentence structure, cohesive devices to construct simple text in regular correspondence like e-mails and letters.*

MODULE-2

UNIT - 1 **8L+0T+8P=16 Hours**

SOCIAL MEDIA – HEALTH AND NUTRITION:

Reading : Reading for factual information researching for supporting evidence - skimming, scanning, Vocabulary building: One-word substitutes.

Writing : Letter Writing- E-mail writing – New age communication – Format, protocol, and style- WhatsApp, Facebook and Twitter Functional grammar: Common Errors in Sub-Verb Agreement and Modals.

Listening : Listening to a Business Presentation: Listening for deducing information, for abstract details and specific details, listening for taking a message.

Speaking : Making a presentation with a PPT on a topic assigned- organising the presentation using appropriate discourse markers - presenting a point of view - Extempore.

UNIT-2 **8L+0T+8P=16 Hours**

FASHION:

Reading : Reading for data interpretation and information transfer from graphical aids to text reports (pictograms. tables, graphs, pie charts, flow charts), deducing specific information and general information

Vocabulary building: Business vocabulary, collocations, idioms and phrasal verbs.

Writing: Writing a Report: Drafting general and factual reports - writing an overview - an effective introduction - organising information into paragraphs (Stages of writing: planning /organising /writing / editing /rewriting)

Functional grammar: Transformations and miscellaneous common errors.

Listening : Listening to a Ted talk and sorting information – taking notes from a discussion.

Speaking : Group Discussion – prerequisites -generating content - initiating a discussion - expressing one's opinion ~ leading a discussion - agreeing/ disagreeing to someone's view - cutting into a speech - body language and voice modulation.

PRACTICES:

- E-mail writing.
- Letter writing.
- Report writing.
- Messaging in Social media.
- Extempore.
- Making PPTs.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply a variety of strategies to interpret and comprehend spoken texts/ discourse using contextual clues.	Apply	1	6, 7, 8, 9, 10, 12
2	Apply appropriatereading strategies to interpret content / material related to engineering and technology domain.	Apply	1	6, 7, 8, 9, 10, 12
3	Possess an ability to write clearly on topics related to technology and workplace communication.	Analyze	2	6, 7, 8, 9, 10, 12
4	Choose functional language, grammar structures, cohesive devices and skills of organisation to express clearly in speaking.	Evaluate	2	6, 7, 8, 9, 10, 12
5	Participate in discussions and make short presentations on general and technical topics.	Create	2	6, 7, 8, 9, 10, 12

LANGUAGE LAB ACTIVITIES

Session - 1: Dictionary Skills

Session - 2: Introduction to Phonetics and Identifying Phonemes

Session - 3: Pronunciation Practice (Commonly mispronounced words)

Session - 4: Rosetta Stone (Exercises on LSRW)

Session - 5: Listening Comprehension (Summarising exercise on a Ted Talk)

Session - 6: Technical Presentations (Individual)

Session - 7: Technical Presentations (Team)

Session - 8: TOEFL Mastery

TEXT BOOK:

1. N P Sudharshana & C Savitha, “English For Technical Communication”, Cambridge University Press, 2016.

REFERENCE BOOKS:

1. Balasubramanian T,“A Text book of Phonetics for Indian Students”, Orient Longman, New Delhi, 1989.
2. Krishnaswamy, N and Sriraman, T, “Current English for Colleges”, Trinity publications, 2016.
3. Mohan Krishna and Meera Banerjee, “Developing Communication Skills”, Macmillan India Ltd. New Delhi, 1990.
4. Ashraf Rizvi M, “Effective Technical Communication”, 2nd Edition, McGraw Hill Education, 2017.
5. Narayana Swamy V R, “Strengthen your Writing”, Third Edition Orient Black Swan, New Delhi, 2005.

22BM101 CLINICAL BIOCHEMISTRY

https://www.aior.co.in/img/clinical-biochemistry-department.jpg

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Basics of Chemistry.

COURSE DESCRIPTION AND OBJECTIVES:

This course enables to understand the structural, functional & biological significance of carbohydrates, lipids, proteins & nucleic acids. Familiarizes with the biochemistry & metabolic disorders of biomolecules. Topics of this course include enzyme activity, metabolic pathways, biotransformation and molecular biology. It elaborates the biochemical buoyance mechanism of the body. It offers theoretical and hands on experience of biological fluid analysis and immunoassay responses.

MODULE–1

UNIT-1 **8L+0T+8P=16 Hours**

INTRODUCTION TO BIOLOGICAL FLUIDS:

Properties of Water to act as biological fluid, Acids and Bases, pH, Buffers, Handersen - Hasselbalch equation, Physiological buffers, Biological fluid properties: Viscosity, Surface tension, Osmosis, Diffusion, Adsorption. Fitness of the aqueous environment of living organisms. Biological significance of biomolecules - Carbohydrates, Proteins, Amino acids, Lipids and Nucleic acids.

UNIT-2 **8L+0T+8P=16 Hours**

BIOMOLECULES:

Carbohydrate metabolism, Respiration-types, Glycolysis and Kreb's cycle and energetics involved, Hyper glycaemia, Hypo glycaemia, Diabetes mellitus, Diabetes insipidus, Lipid metabolism, Ketogenesis, β-oxidation, Cholesterol. Cholesterol pathways (Transport & reverse transport) Metabolic disorders of biomolecules.

PRACTICES:

- Quantitative estimation of PH values
- Analysis of Chromatography of amino acids
- Colorimetric & Spectrophotometric determination of biomolecules
- Analysis of Plasma protein electrophoresis
- Quantitative estimation of Glucose
- Quantitative estimation of Urea
- Identification of ketone bodies
- Estimation of cholestrol in serum - Lipid profile

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

ENZYME CHEMISTRY:

Chemical nature of enzymes - Study of the properties of enzymes and kinetics by Spectrophotometer, Michael-Menton concept, Diagnostic and therapeutic uses of Enzymes, Metal ions in biological catalysis (explanation with few examples).

SKILLS:

- ✓ *Functioning and understanding of various body fluids.*
- ✓ *Learn different data and number representations.*
- ✓ *Design ALU and Control unit.*
- ✓ *Identify the types of memories and their uses.*
- ✓ *Interpretation of harnessing of energy in organ system*
- ✓ *Explain the basis for enzyme kinetics.*

NUCLEIC ACIDS & IMMUNO ASSAYS:

Nucleic acid chemistry, Protein synthesis, Transcription and translation, Replication, Polymerase chain reaction (PCR) immunological techniques or Immunoassay.

– Radio immuno assay (RIA), Enzyme - Linked immunosorbent assay (ELISA), Chemiluminiscence.

UNIT-2 **8L+0T+8P=16 Hours**

BIOLOGICAL FLUID ANALYSIS:

Blood Chemistry - Chemical composition of blood, Separation of serum, Proteins and lipoproteins by electrophoresis and ultracentrifugation acid base balance and biochemical measurements of acid-base and electrolyte status of the patients, Urine analysis, General methods of biochemical analysis carried out in the estimation of blood constituents, such as glucose etc,

Principles and different methods of chromatography – Fluorometry, Flame photometry, Automation and biochemical analysis, Applications of isotopes in biochemistry.

PRACTICES:

- Determine the Salivary Amylase response Vs. Temperature
- Estimate the Enzyme Kinetics quantitatively.
- Estimate the Creatinine quantitatively.
- Analysis of Urine compositions
- Analysis of biochemicals in blood constituents
- Determine the Enzyme - Linked immunosorbent assay
- Flame Photometry-Analysis of Na and K in an unknown sample
- CLIA & ECLIA (Chemiluminiscence Immuno Assay & Enhanced Chemiluminescence Immuno Assay)

COURSE OUTCOMES:

Upon successful completion of this course, students will have to ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Determine the enzyme action and their concentrations	Analyze	1	1, 2, 9,10,12
2	Apply Handersen-Hasselbalch equation for finding out Ph of buffers; apply principles of viscosity and other mechanisms to living organisms	Apply	1	1, 2, 5, 9,10,12
3	Analyse the physiochemical properties of carbohydrates, lipids, proteins and metabolic pathways and disorders associated.	Analyze	1	1, 2, 3, 5, 9,10,12
4	Analyze the enzyme action with their concentrations and their role in therapeutic applications	Analyze	2	1, 2, 9,10,12
5	Evaluate the immune responses and analysis the human body biochemistry with chemical analysers.	Evaluate	2	1, 2,9,10

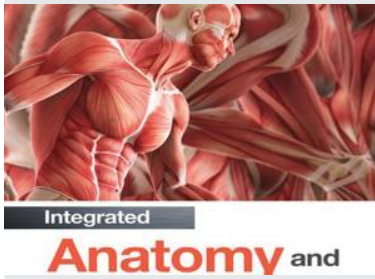
TEXT BOOKS:

1. RC Guptha, S.Bhargava, “Practical Biochemistry”, CBS Publisher, 2022.
2. Denise R Ferrier “Lippincott Biochemistry Lippincott’s Illustrated Reviews”, south Asian edition, wolters Kulwer, 2020.

REFERENCE BOOKS:

1. Gaw, “Clinical Biochemistry”, 1st edition, Ellis Horwood Ltd, 2013.
2. DM. Vasudevan, Sreekumari S, Kannan Vaidyanathan, “Textbook of Biochemistry for Medical Students”, 9th edition, Jaypee Brothers Medical Publications, 2019.
3. William J. Marshall, “Clinical Biochemistry: Metabolic and Clinical Aspects” Churchill Livingstone; 3rd edition,2014.

22BM102 FUNDAMENTALS OF ANATOMY AND PHYSIOLOGY



https://www.bluedoorpublishing.com/products/integrated-anatomy-and-physiology-for-allied-health

Hours Per Week :

L	T	P	C
2	1	2	4

PREREQUISITE KNOWLEDGE: Basics of Biology.

COURSE DESCRIPTION AND OBJECTIVES:

This course provides a comprehensive study of the anatomy and physiology of the human body. Topics include in this course are body organization; respiratory, skeletal, circular, urinary, nervous systems and special senses systems. To know basic structural and functional elements of human body. To learn about organs and structures involving in system formation and functions.

MODULE–1

UNIT-1 **6L+3T+6P=15 Hours**

BASIC ELEMENTS OF HUMAN BODY:

Cell structure and Functions, Cell membrane and transport, cell membrane action potential, Tissue - types, specialized tissues.

MUSCULO-SKELETAL SYSTEM: Functions. Skeletal system, muscular system Physiology of muscle contraction, NMJ, types of muscles in limbs, locations and their actions.

UNIT-2 **10L+5T+10P=25 Hours**

NERVOUS SYSTEM:

Structure and types of a neuron, Synapses and types, Conduction of action potential in neuron; Central nervous system, P.N.S - spinal reflex, reflex action, ANS – sympathetic and para sympathetic systems, Special senses.

CIRCULATORY SYSTEM: Blood composition and Functions, blood groups, Structure of heart- Properties of cardiac muscle, cardiac cycle, heart sound, circulatory system.

PRACTICES:

- Identify major regions of the cell (cytoplasm, nucleus, plasma membrane) on a model and/or diagram and summarize major functions of each
- Analyse the Histology-Slides of primary tissues of body
- Analyse the human skeleton System
- Analyse the human upper and lower limb muscles
- Determine the mechanical response of the muscle on application of induced electric signal.
- Determination the brain meninges: dura mater, arachnoid mater, & pia mater
- Determination the structural features of the brain: gyrus, sulcus, fissure
- Determine the rate of conduction of nerve impulse.
- Determination the blood groups, hemoglobin content /percentage of blood, RBC and WBC count of blood and bleeding and clotting time.
- Measuring Blood Pressure and Pulse Rate

MODULE-2

UNIT-1 **8L+4T+8P=20 Hours**

RESPIRATORY SYSTEM: Components of respiratory system, Respiratory mechanism, Types of respiration, Respiratory volumes.

SKILLS:

- ✓ *Location of body parts and identification.*
- ✓ *Know the various tissues and their appearances.*
- ✓ *Know the physics behind respiratory systems.*
- ✓ *Circulatory system's working principle.*

UNIT-2 **8L+4T+8P=20 Hours**

URINARY AND REPRODUCTIVE SYSTEM:

Urinary system - Structure of kidney and nephron; Mechanism of urine formation and acid base regulation, urinary reflex, Homeostasis and blood pressure regulation by urinary system; Reproductive system - parts of male and female reproductive system, spermatogenesis and hormonal regulation; Oogenesis, Menstrual cycle.

PRACTICES:

- Determination the Lung volume and capacities
- Measurements of Breathing During Resting and Active Modes
- Analyze reproductive and urinary organ tissues
- Demonstrate the organs of the urinary system: kidney, ureter, urinary bladder and urethra, as well as the structural elements of the nephron and label on any available models
- Compare and contrast the elements of the male and female reproductive systems and their associated accessory glands.

COURSE OUTCOMES:

Upon successful completion of this course, students will have to ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Distinguish amongst different specialized tissues, bones and muscle types	Analyze	1	1, 2, 9,10,12
2	Analyse the structural and functional aspects of nervous system and special senses using sketches and electrophysiology	Analyze	1	1, 2, 5, 9,10,12
3	Analyse the fluids exchange & electrophysiology in cardiovascular and respiratory systems by using various physics laws	Analyze	2	1, 2, 3, 5, 9,10,12
4	Categorize the physiological aspects on blood and organ systems using hospital grade equipment.	Analyze	2	1, 2, 9,10,12
5	Evaluate the urine formation & predict reproduction cycles based on ion exchanges in kidney and human reproductive system.	Evaluate	2	1, 2,9,10

TEXT BOOKS:

1. Elaine.N.Marieb, "Essential of Human Anatomy and Physiology",12th edition, Pearson Education, 2017.
2. Gerard J. Tortora, Bryan D. "Principles of Anatomy and Physiology", 14th edition, John Wiley & Sons INC, 2014

REFERENCE BOOKS:

1. Kevin T. Patton, Gary A. Thibodeau, "The Human Body in Health & Disease", Oxford University Press, USA, 2017.
2. William F. Ganong, "Review of Medical Physiology", 22nd edition, Mc Graw Hill, 2015.
3. Eldra Pearl Solomon, "Introduction to Human Anatomy and Physiology", 4th edition, W.B. Saunders Company, Harcourt Brace Jovanovich, 2015.
4. Harminder Singh, "Fundamentals of Medical Physiology", 12th edition, Elsevier Saunders, 2018.

II

YEAR

B.Tech.

BIOMEDICAL ENGINEERING

I SEMESTER

22CT201	-	Environmental Studies
22TP201	-	Data Structures
22BM201	-	Analog Electronic Circuits
22BM202	-	Basic Clinical Sciences
22BM203	-	Electrical Circuit Theory
22BM204	-	Biomedical Instrumentation
22BM205	-	Hospital Management
22SA201	-	Life Skills-I

II SEMESTER

22ST204	-	Biostatistics
22TP203	-	Advanced Coding Competency
22BM206	-	Analog and Digital ICs
22BM207	-	Biomaterials and Artificial Organs
22BM208	-	Biomedical Signals and Systems
22TP204	-	Professional Communication
	-	Open Elective – 1

COURSE CONTENTS

I SEM & II SEM

22CT201 ENVIRONMENTAL STUDIES

Image source: Biogas plant at VFSTR

Hours Per Week :

L	T	P	C
1	1	0	1

PREREQUISITE KNOWLEDGE: General awareness regarding environmental problems and importance of environmental protection

COURSE DESCRIPTION AND OBJECTIVES:

It is a multidisciplinary subject where different aspects of society and environment are dealt using a holistic approach. It is evolving to be the education for sustainable and ethical development both at a local and global level. It helps to prepare the next generation for planning appropriate strategies to address environmental issues. It identifies and creates solutions that conserve to manage ecosystem and biodiversity and helps to eliminate pollutants, toxicants, preserve air, water and soil quality. Environmental education recognizes impacts of global issues, enhances the public awareness and helps to take decisions towards environmentally responsible actions.

MODULE-1

UNIT-1 **4L+4T+0P=8 Hours**

INTRODUCTION TO ENVIRONMENT: NATURAL RESOURCES, ECOSYSTEMS AND BIODIVERSITY:

Environment and sustainable development; Natural resources- forest, water, energy and land resources; Ecosystem – basic structural components, function and interactions in ecosystem, ecological succession.

UNIT-2 **4L+4T+0P=8 Hours**

BIODIVERSITY AND CONSERVATION:

Introduction to biodiversity, types of biodiversity- species, genetic and ecosystem diversity; Threats to biodiversity - natural and anthropogenic, species extinctions, man wildlife conflicts; Biodiversity conservation - principles and strategies; in-situ and ex-situ conservation.

PRACTICES:

- Visit to a Biogas plant, Solar Power plant.
- Visit to a local area: river / pond / lake / forest / grassland / hill / mountain and study of different types of ecosystems, biodiversity study and documentation (herbarium sheet preparation).
- Set up an aquarium.
- Case study: Renewable energy use.

MODULE-2

UNIT-1 **4L+4T+0P=8 Hours**

ENVIRONMENTAL POLLUTION AND CLIMATE CHANGE:

Air, water, soil, radioactive and noise pollution; Study of different pollutants (SOx, NOx, PAN, PAH etc.); Toxicity study; Climate change - greenhouse effect, acid rain, ozone layer depletion.

UNIT-2 **4L+4T+0P=8 Hours**

POLLUTION CONTROL DEVICES AND WASTEWATER TREATMENT TECHNOLOGIES:

Air pollution control devices - Gravitational settling chambers, cyclonic separators, electrostatic precipitators, fabric filters and bio filters, Wastewater management.

SKILLS:

- ✓ *Create a bio-diversity map of any habitat/ ecosystem.*
- ✓ *Strategize different ways of using renewable energy resources.*
- ✓ *Design novel strategies and approaches for pollution control and waste management.*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the basic concepts of sustainable development, natural resource utilization and ecology for the purpose of environmental protection	Apply	1	1,6,7, 9, 10, 11, 12
2	Analyze the biodiversity of different ecosystems and formulate various conservation approaches	Analyze	1	1, 7, 8, 9, 10, 11, 12
3	Analyze the presence of various environmental pollutants	Analyze	2	1, 6,7,9, 10, 11, 12
4	Recommend various waste management approaches and their implementation strategies	Evaluate	2	1,2, 7,8,9,10,11, 12
5	Design remediation technologies for their abatement	Creative	2	1, 3,6,7, 9, 10, 11, 12

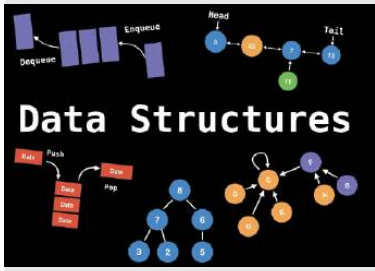
TEXT BOOKS:

1. A. Kaushik and C. P. Kaushik, “Perspectives in Environmental Studies”, New Age International Publishers, 5th Edition, 2016.
2. Y. Anjaneyulu, “Introduction to Environmental Science”, B. S. Publications, 2015.

REFERENCE BOOKS:

1. B. Joseph, “Environmental Studies”, Mc Graw Hill Education, 2nd Edition, 2015.
2. S. Subash Chandra, “Environmental Science”, New Central Book Agency, 2011.
3. M. Basu and S. Xavier, “Fundamentals of Environmental Studies”, Cambridge University Press, 2016.
4. K. Mukkanti, “A Textbook of Environmental Studies”, S. Chand Company Ltd., 2009.
5. M. Anji Reddy, “A Textbook of Environmental Science and Technology”, B. S. Publications, 2008.

22TP201 DATA STRUCTURES



Source: https://www.youtube.com/watch?v=Qmt0QwzEmh0

Hours Per Week :

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Programming in C.

COURSE DESCRIPTION & OBJECTIVES:

This course is aimed at offering fundamentals concepts of data structures and explains how to implement them. It begins with the basic concepts of data, data structures and then introduces the primitive and non-primitive data structures in detail. It forms the basis for understanding various ways of representing data and its usage in different computing applications.

MODULE-1

UNIT-1 **5L+6T+6P = 17 Hours**

DATA STRUCTURES BASICS:

Basic Terminology – data, information, datatype; Data Structures – Introduction, storage structures-sequential and linked storage representations; classification of data structures; Applications of data structures.

Sorting: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort and Merge Sort.

Searching: Linear Search and Binary Search.

UNIT-2 **11L+10T+10P = 31 Hours**

LINKED LISTS AND STACKS, QUEUES:

Linked List: Introduction, Types of linked list – Singly linked list, doubly linked list and circular linked list, representation of linked list, Operations of linked list: Traverse forward/ reverse order, searching, insertion and deletion; Applications of linked lists.

Stack – Introduction, array and linked representations, implementation and their applications; Queue – Introduction, array and linked representations, implementation; Types – Linear, circular and doubly ended queues – operations; Applications of Queues.

PRACTICES:

Problems on Recursion – Level 1

- Find the product of 2 numbers using recursion.
- Find the sum of natural numbers using recursion.
- Find the factorial of a number using recursion.
- Find the Nth term of Fibonacci series using recursion.
- Calculate the power using recursion.
- Write a recursive program for checking if a given number is a prime number.
- Given two integers write a function to sum the numbers without using any arithmetic operators.
- Convert a decimal to binary using recursion.
- Print all factors using recursion.
- Find the maximum product of digits among numbers less than or equal to N.

SKILLS:

- ✓ *Experienced to Store data and various types of data to handle.*
- ✓ *Ordering and sorting of data.*
- ✓ *Indexing and Searching of required data from large data sequences.*
- ✓ *Exposed to various characteristics such as Linear or non-linear, Homogeneous or heterogeneous and Static and Dynamic.*

Problems Recursion – Level 2

- Implement insertion sort recursively.
- Write a program to find the numbers less than N that are product of exactly 2 distinct prime numbers - using recursion.
- Implement selection sort recursively.
- Find the middle of a singly linked list using recursion.
- Find the sum of even numbers of an array using recursion.
- Check if a given array is in sorted order using recursion.
- Print alternate nodes of a linked list using recursion.
- Reverse a doubly linked list using recursion.
- Write a recursive function that returns all permutations of a given list.
- Implement bubble sort recursively.

Problems on Sorting and Searching – Level 1

- Implement the insertion sort function.
- Implement the bubble sort function.
- Implement the quick sort function.
- Implement the merge sort function.
- Implement the selection sort function.
- Implement linear search function.
- Implement binary search function.

Problems on SLL – Level 1

- Implement the insert function to insert nodes into a singly linked list (ascending order).
- Implement the insert function to insert nodes into a singly linked list (descending order).
- Implement the search node function.
- Implement the delete node function.
- Display forwards function.
- Display backwards function.
- Count the number of nodes in a singly linked list.
- Swap alternate nodes of a singly linked list.
- Move last node to the front of the linked list.
- Move first node to the last of the linked list.

Problems on Stacks – Level 1

- Implement two stacks using a single array.
- Given an array replace every element with nearest greater element on the right.
- Given a stack reverse the elements using only push and pop functions.
- Postfix evaluation using stack.
- Balance symbols.
- Find middle element in a stack.
- Remove middle element from a stack.
- Implement push and pop using linked list.
- Given an array of characters with the middle marked by X, check if the string is a palindrome.
- Maximum sum in sliding window.

Problems on Queues – Level 1

- Write a program to accept two numbers as input check if they are equal.
- Write a program to accept two characters as input and check if they are equal.
- Write a program to accept two numbers as input and print the greater of the 2 numbers.
- Write a program to accept two numbers as input and print the lesser of the 2 numbers.
- Write a program to accept 3 numbers as input and print the maximum of the 3.
- Write a program to accept 3 numbers as input and print the minimum of the 3.
- Write a program to accept a number as input and print EVEN if it is an even number and ODD if it is an odd number.
- Write a program to accept a number as input and check if it is divisible by 3. If it is divisible by 3 print YES else print NO.
- Write a program to accept a number as input and check if it is divisible by both 3 & 5. If it is divisible print YES else print NO.
- Write a program to accept a number as input and check if it is positive, negative or zero.

Problems on DLL – Level 1

- Implement insert function.
- Implement display forward function.
- Implement display backward function.
- Implement search function.
- Implement delete function.
- Reverse a doubly linked list from M to N.
- Find the sum of the odd and even nodes.
- Count odd keys of the linked list.
- Merge two sorted lists.
- Delete adjacent duplicate nodes.

Problems on CLL – Level 1

- Insert function (circular doubly linked list).
- Search function.
- Display forward.
- Display backward.
- Delete node (circular doubly linked list).
- Print the middle N nodes of a circular singly linked list.
- Move the last node of a circular singly linked list to the beginning.
- Delete adjacent duplicate nodes of a circular singly linked list.
- Delete nodes greater than a value from a circular doubly linked list.
- Find the sum of the nodes of a circular linked list.

Problems on Linked List – Level 2

- Given 2 sorted linked lists, print the common elements.
- Reverse a list (using Stack).
- Given a pointer to a node (not the last node), delete the node.
- Reverse a list (Recursive).
- Reverse a list (Iterative).
- Reverse a singly linked list in pairs (recursive).
- Reverse a singly linked list in pairs (iterative).
- Check if a singly linked list is a palindrome or not.
- Remove the loop if exists.
- Given 2 linked lists with data in the ascending order, merge them into a single list.

MODULE-2

UNIT-1 **8L+8T+8P=24 Hours**

TREES:

Trees: Basic Terminology, Types of Trees, Binary Tree – Introduction, properties, array and linked representations; Tree traversals and their implementation; Expression trees; BST – definition and operations, AVL trees – definition and construction; Applications of binary trees.

UNIT-2 **8L+8T+8P=24 Hours**

GRAPHS & HASHING:

Graphs: Basic Terminology, Types of Graphs, Graphs representations – adjacency matric, adjacency list; Traversals - breath first search and depth first search; Applications of graphs.

Hashing: Introduction, Different hash functions, collision: avoidance and handling methods.

PRACTICES:

Problems on BST – Level 1

- Insert function.
- Insert function (recursive).
- Search function.
- Pre order traversal.
- Post order traversal.
- In order traversal.
- Level order traversal.
- Delete child node.
- Delete parent node.
- Delete nodes greater than a value from a circular doubly linked list.

Problems on Priority Queues – Level 1

- Meeting rooms problem.
- Ugly number.
- Find median from data stream.
- Find the top K frequent elements.
- Find K Pairs with smallest sums.
- Find the Kth smallest element in a sorted matrix.
- Trapping Rain Water.
- Rearrange String k distance apart.
- Sort characters by frequency.
- Solve the maze problem.

Problems on Graphs – Level 1

- Implement Graph data structure.
- Implement BFS - iterative solution.
- Implement BFS - recursive solution.
- Implement DFS - iterative solution.
- Implement DFS - recursive solution.
- Check if given graph is strongly connected or not.
- Check if given graph is strongly connected or not - using DFS.
- Given a graph find the arrival and departure time of its vertices in DFS. Arrival time is the time when the vertex was explored for the first time, and departure time is the time at which all the neighbours are explored and are ready to backtrack.
- Given a directed acyclic graph and a source vertex, find the cost of the shortest path from source vertex to all other vertices present in the graph. If a vertex cannot be reached from given source vertex that distance may be printed as infinite.
- Given an undirected graph, check if the graph is 2 edge connected or not.

Problems on Hashing – Level 1

- Print a binary tree in vertical order.
- Find whether an array is subset of another array.
- Given an array A [] and a number x, check for pair in A [] with sum as x.
- Minimum operation to make all elements equal in array.
- Maximum distance between two occurrences of same element in array.
- Check if a given array contains duplicate elements within k distance from each other.
- Find duplicates in a given array when elements are not limited to a range.
- Most frequent element in an array.
- Smallest subarray with all occurrences of a most frequent element.
- First element occurring k times in an array.

Problems on Graphs – Level 2

- Find the shortest graph distances between every pair vertex in a given path. Assume that the graph does not have any negative edges.
- Find the shortest graph distances between every pair of vertices in a given path. The graph can have negative edges.
- Detect cycle in DFS.
- Count the number of connected components of a graph represented in the adjacent matrix.
- Count the number of connected components of a graph represented in the adjacent matrix - using DFS.
- Find a spanning tree - not necessarily a minimum spanning tree.
- Detect cycle in an undirected graph.
- Given an undirected graph, find its depth.
- Determine if a directed graph has a unique topological ordering.
- Given a directed acyclic graph and two vertices v and w, find the lowest common ancestor.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Explore the organization of several ADTs and the manipulation (searching, insertion, deletion, traversing) of data stored in various data structures.	Apply	1,2	1
2	Apply different data structures to solve a given problem.	Apply	1,2	1
3	Analyze the efficiency of using different data structures and choose the efficient data structure for solving a given problem.	Analyze	1,2	2
4	Develop new algorithms to solve various problems.	Create	1,2	3,4

TEXT BOOKS:

1. Reema Thareja, “Data Structures Using C”, 2nd Edition, Oxford University Press, 2014.
2. Seymour Lipschutz, “Data Structures with C”, 1st Edition, McGraw Hill Education, 2017.

REFERENCE BOOKS:

1. Ellis Horowitz and Sartaj Sahni, “Fundamentals of Data Structures”, illustrated edition, Computer Science Press, 2006.
2. Richard F. Gilberg and Behrouz A. Forouzan, “Data Structures: A Pseudocode Approach with C”, 2nd Edition, CENAGE Learning, 2005.
3. R G Dromey and Pearson, “How to solve it by Computer”, 2nd edition, Impression edition, 1998.

https://www.eletimes.com/the-perennial-role-of-analog-electronics

22BM201 ANALOG ELECTRONIC CIRCUITS

Hours Per Week :

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Engineering Mathematics, Basic Electrical and Electronic Engineering, Basics of Electronics.

COURSE DESCRIPTION AND OBJECTIVES:

This course is aimed at offering fundamental concepts of semiconductor devices and circuits. It starts with the physics concepts that form the basis for semiconductor material formation, then it introduces the Junction Diode, Transistor, FET and other basic devices that are designed with semiconductor materials. It also includes the concepts of simple circuits that are designed with the help of these basic devices. As a first-level course in electronics, it forms the basis to understand advanced electronic courses that will be studied in subsequent semesters.

MODULE–1

UNIT-1 **6L+6T+6P=18 Hours**

SEMICONDUCTOR DIODES & CIRCUITS:

Construction and Working of PN Junction diode & Zener diode, Volt-Ampere characteristics of PN junction & Zener diode, Light emitting diode, Photo diode, LASER.

UNIT-2 **10L+10T+10P=30 Hours**

SMALL SIGNAL ANALYSIS OF BJTS:

Construction, Working of BJT, Small Signal Analysis of CE, CB and CC, Multistage amplifiers.

PRACTICES:

- Characteristics of PN junction diode.
- Zener diode characteristics and Voltage regulator using zener diode.
- Common emitter input-output characteristics.
- Common collector input-output characteristics.
- Common base input-output characteristics.

MODULE-2

UNIT-1 **8L+8T+8P=24 Hours**

SMALL SIGNAL ANALYSIS OF FETs: Construction, Working of JFET & MOSFET, Small signal and low frequency model of JFET, Expressions for voltage gain, Input and output impedances of common source amplifier.

UNIT-2 **8L+8T+8P=24 Hours**

FEEDBACK AMPLIFIERS AND OSCILLATORS:

Negative feedback and Positive Feedback Amplifiers- Voltage, Current, Series, Shunt feedback, RC Phase shift and Wien Bridge Oscillator.

PRACTICES:

- Trans impedance amplifier
- Trans conductance amplifier

- RC Phase shift and
- Wien Bridge Oscillator
- FET characteristics
- Wien bridge oscillator using transistors.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Design half wave and full wave rectifiers and Zener diode as voltage regulator	Creative	1	1, 2, 9,10,12
2	Apply the concepts of basic electronic devices to design various circuits	Apply	1	1, 2, 5, 9,10,12
3	Compare CB, CE, CC configurations of BJT and CG, CD, CS configurations of FET	Analyze	1	1, 2, 9,10
4	Investigate the characteristics of amplifier circuits employing BJT and FET devices	Analyze	2	1, 2, 9,10,12
5	Evaluate different multistage amplifiers and demonstrate negative feedback amplifier circuits and positive feedback oscillators	Evaluate	2	1, 2,9,10,12

TEXT BOOKS:

1. Sedra and Smith, “Microelectronic Circuits”, 6th edition, Oxford University Press, 2020
2. S Salivahanan, N Suresh Kumar,” Electronic devices and circuits”, 5th edition, Tata McGraw Hill India, 2022.

REFERENCE BOOKS:

1. M.H. Rashid, “Microelectronic Circuits: Analysis and Design”, 3rd edition, Cengage Learning, 2016.
2. Thomas L. Floyd, “Electronics Fundamentals Circuits, Devices, and Applications”, 8th edition, Prentice Hall of India, 2019.
3. Donald A. Neamen, “Electronic Circuit Analysis and Design”, 3rd Edition, Tata McGraw Hill, 2013.
4. Robert B. Northrop, “Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation”, 1st edition, CRC Press, 2014.

SKILLS:

- ✓ *Identify a semiconductor diode for a specific application and power handling capacity.*
- ✓ *Identify the transistor type for a given application (switch/amplifier).*
- ✓ *Recognize the require specifications of the transistor.*
- ✓ *Identify the amplification factor required.*
- ✓ *Test the working condition of the transistor.*

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22BM202 BASIC CLINICAL SCIENCES

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: : Fundamentals of Anatomy & Physiology.

COURSE DESCRIPTION AND OBJECTIVES:

A clinical science gives a perceptive to students on various aspects of clinical diseases and the measurable parameters for diagnosis and gives a view on instruments for treatment and other assistive devices.

MODULE-1

UNIT-1 **8L+8T+0P=16 Hours**

NEPHROLOGY:

Principles and types of dialysis, Components of dialyzing system, Dialysate, Composition of dialysate, Types of dialyzers, Clinical significance, Renal transplantation

UNIT-2 **8L+8T+0P=16 Hours**

NEUROLOGY:

Diseases of nervous system (Alzheimer's disease, Parkinson's disease, ALS), Spinal cord lesions, Motor nervous disease, Prolapsed intervertebral disc, Neuropathies, Myasthenia gravis, Diseases of muscle - myopathy.

PRACTICES:

- Design a proto type of reusable dialyzer
- Design a Portable dialyzer
- Records the brain's continuous electrical activity through electrodes attached to the scalp.
- Records the brain's electrical response to visual, auditory, and sensory stimuli
- Case Study: Critical analysis of the symptomatic and asymptomatic symptoms of Alzheimer's disease, Parkinson's disease, ALS.

MODULE-2

UNIT-1 **8L+8T+0P=16 Hours**

GASTROENTEROLOGY:

Anatomy and physiology and G.I.T diseases - stomach (ulcers), liver (jaundice), gall bladder (gall stone); Disease diagnosis and treatment, Juices-Gastric, Bile, Pancreatic, Intestinal, functions and clinically significant symptoms - signs, diseases, Instruments used in gastroenterology.

UNIT-2 **8L+8T+0P=16 Hours**

GENERAL SURGERY:

Clinically significance, Preoperative care, Postoperative care, Study of operation of surgical equipment, Laparoscopy, Endoscopy and intubation tubes.

PATHOLOGY& BLOOD BANK: Blood bank, blood groups, ESR, Electrolyte estimation of normal values, HIV test - ELISA, dot method, cross matching of blood, cell counter, normal blood coagulation factors, normal bilirubin.

PRACTICES:

- Distinguish different diagnostic test process of gastrointestinal disorders.
- Evaluate the Instruments used in gastroenterology.
- Case Study: Pre and Postoperative care of cancer patient.
- Evaluate the Laparoscopy, Endoscopy and intubation tubes.
- Determination the ESR/ELISA/blood cell counting (dot/cross matching method) using microscope.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the concepts of dialysis to analyse the performance of dialysis of treatment and design of dialyzer	Apply	1	1, 2, 9,10,12
2	Apply the conditions and symptoms for identification of neurological diseases	Apply	1	1, 2, 5, 9,10, 12
3	Analyse the diseases of the GI tract and instruments used for diagnosis.	Analyze	2	1, 2, 3, 5, 9,10
4	Analyse the conditions of patient in pre and post-operative cares of patient	Analyze	2	1, 2, 5, 9,10
5	Categorize the blood transfusion compatibility based on grouping and other important factors using the blood cell counters/ESR/ELISA	Evaluate	2	1, 2,9,10

TEXT BOOKS:

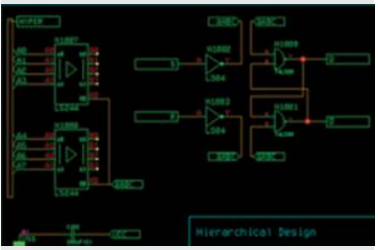
1. Elaine.N.Marieb, “Essential of Human Anatomy and Physiology”,12th edition, Pearson Education, 2017.
2. Gerard J. Tortora, Bryan D. “Principles of Anatomy and Physiology”, 14thedition, John Wiley & Sons INC, 2014

REFERENCE BOOKS:

1. Michael Zigmond, Joseph Coyle, Lewis Rowland, “Neurobiology of Brain Disorders”, Academic Press, 2014.
2. Jeffrey A. Morgan, Andrew B. Civitello, O.H. Frazier, “Mechanical Circulatory Support for Advanced Heart Failure”, Springer, 2018.
3. Jones DB, Wu JS, Soper NJ, “Laproscopic surgery: Principles and Procedures”, 2nd edition, Marcel Dekker, 2019.

SKILLS:

- ✓ *Demonstration of instruments and kidney transplantation*
- ✓ *Analyse the various diseases and their appearances.*
- ✓ *Determine the physics behind diagnostic instruments.*
- ✓ *Application of Pre and Post-operative care procedures*



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22BM203 ELECTRICAL CIRCUIT THEORY

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Engineering Mathematics, Basic Electrical and Electronics Engineering.

COURSE DESCRIPTION AND OBJECTIVES:

This course enables the students to learn concepts in circuit analysis which are applicable in solving electronic circuits. The aim of this course to introduce the student to understand basic passive elements, circuit analysis using different theorems, resonance circuits, steady state response of circuits to sinusoidal excitation in time domain, and two-port network analysis.

MODULE-1

UNIT-1 **6L+6T+0P=12 Hours**

INTRODUCTION TO CIRCUIT ELEMENTS AND METHODS OF ANALYSING CIRCUITS:

Circuit Elements and Kirchhoff's Laws, Mesh and Nodal analysis, Star and delta conversions.

UNIT-2 **10L+10T+0P=20 Hours**

NETWORK THEOREMS:

Superposition, Thevenin's, and Norton's, Maximum power transfer, Reciprocity, Compensation, and Duality-dual networks.

PRACTICES:

- Apply KVL and KCL
- Analyse different networks with dependent and independent sources
- Apply mesh and nodal analysis
- Apply Millman's theorem to D.C. circuits
- Apply Thevinin's and Norton's theorem to DC network
- Apply Maximum power transfer theorem to D.C. circuits
- Apply Dual networks.

MODULE-2

UNIT-1 **8L+8T+0P=16 Hours**

AC VOLTAGE & CURRENTS, AND RESONANCE: I

ntroduction to alternating voltages and currents, Resonance- Series and parallel resonance circuits, Concept of bandwidth and Q-factor.

UNIT-2 **8L+8T+0P=16 Hours**

TWO PORT NETWORKS: I

ntroduction to Two port networks, Open circuit impedance (Z) and short circuit admittance (Y), Transmission (ABCD), and Hybrid parameters (h), Relation between parameter sets.

PRACTICES:

- Find the different parameters of different waveforms
- Find the response of the network for sinusoidal excitation

- Series RLC network
- Parallel RLC network
- Two port network parameters and inter relation
- Solving different two-port networks using Z, Y and ABCD parameters.

SKILLS:

- ✓ *Understand different components and their characteristics.*
- ✓ *Able to analyze/ find responses using theorems.*
- ✓ *The behavior of RL/RC/RLC can be evaluated for different inputs.*
- ✓ *Able to analyze regulated power supply.*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply Kirchhoff's laws and theorems to linear circuits.	Apply	1	1, 2, 4, 5, 9, 10, 12
2	Analyze current and voltage behaviour for the given circuit under transient conditions.	Analyze	2	1, 2, 3, 5, 9, 10
3	Analyze the given network using specified two port network parameter like Z or Y or T or h.	Analyze	2	1, 2, 3, 5, 9, 10
4	Evaluate the steady state analysis of RL, RC and RLC circuits and resonance.	Evaluate	2	1, 2, 3, 4, 5, 9, 10, 12

TEXT BOOKS:

1. A. Sudhakar and Shyammohan S Palli, "Circuits & Networks: Analysis and Synthesis", 5th edition, Tata McGraw-Hill, 2017
2. M. E. Van Valkenburg, "Network Analysis", Prentice-Hall of India Pvt Ltd, New Delhi, 2015.

REFERENCE BOOKS:

1. Mahmood Nahvi and Joseph Edminister, "Electric Circuits", 8th edition, Schaum's Outline series, Tata McGraw-Hill, 2020.
2. William H. Hayt, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuit analysis", 8th edition, Tata McGraw-Hill,2017.
3. A Sudhakar and Shyammohan S Palli, "Circuits & Networks: Analysis and Synthesis", 5th edition, Tata McGraw-Hill,2017.
4. William H. Hayt, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis", 8th edition, Tata McGraw-Hill, 2017.
5. Franklin F.Kuo, "Network Analysis and Synthesis", 2nd Edition, John Wiley and Sons, 2013.

https://www.info 4eee.com/2014 /04/ introduction -to-biomedical.html

22BM204 BIOMEDICAL INSTRUMENTATION

Hours Per Week :

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Analog Electronic circuits.

COURSE DESCRIPTION AND OBJECTIVES:

This course includes the basic and advanced principles, concepts, and operations of medical sensors and devices, the origin and nature of measurable physiological signals and also including design of electronic instrumentation. This course aimed to impart the knowledge of realistic design and experimentation with amplifiers for biopotential measurement.

MODULE-1

UNIT-1 **6L+6T+6P=18 Hours**

MEDICAL INSTRUMENTATION:

Block diagram; Bio-signals: Bio potentials-ECG, EEG, EGG, EMG, ENG, EOG, and ERG; Problems encountered with measurements from human beings; specifications, Electrode - electrolyte interface, half-cell potential, offset voltage; Types of Electrodes - external, internal and microelectrodes; Mathematical treatment of electrodes – equivalent circuits and applications.

UNIT-2 **10L+10T+10P=30 Hours**

DISPLAY DEVICES AND RECORDERS:

Display devices, requirements for display and recording of biosignals, Types of medical display devices; Medical recorders- classification of recorders, Oscilloscopes- CRO, Dual beam oscilloscope, analog and digital storage oscilloscope, multi beam and non-fade display systems; LCD - introduction, passive-matrix and active, matrix addressed LCDs.

PRACTICES:

- Demonstrate wet, dry and gel electrode configurations using Impedance analyzer.
- ECG, EEG and EMG signals acquire and analyze by using simulator and real time
- Develop and apply equivalent circuits for biomedical instruments
- Demonstrate the Display devices and medical recording

MODULE-2

UNIT-1 **8L+8T+8P=24 Hours**

CARDIAC INSTRUMENTATION:

ECG block diagram and circuits, Electrodes and their placement; Lead configuration and ECG waveforms; ECG monitors - single and multi-channel ECG systems, Holter monitors, stress test systems. Blood flow measurement electromagnetic and ultrasonic techniques; Phonocardiography, Cardiac Pacemaker.

NEURO-MUSCULAR INSTRUMENTATION: EEG block diagram and circuits, Electrodes placement, Lead configuration and EEG graphs; Evoked potentials, Filters for EEG rhythm analysis, EMG - EMG block diagram and circuits, Electrodes placement; NCV, Stimulators for EMG recording.

UNIT-2 **8L+8T+8P=24 Hours**

MEDICAL ANALYTICAL INSTRUMENTATION:

Methods of chemical analysis, Absorption photometry, Emission photometry, Flurometry, Colorimeter, Spectrophotometer, Flame photometer, Mass spectrophotometer, Chromatography, Blood gas analyzer, Semi and fully automated analyzers.

PRACTICES:

- Design of Instrumentation amplifiers for ECG/ EEG/ EMG.
- Design of filters for ECG/ EMG/ EEG.
- Apply Holter monitors technique to ECG
- Colorimeter and Spectrophotometer.
- Electrophoresis

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Classify characteristics of biopotentials	Apply	1	1, 2, 9,10, 12
2	Apply the volume conductor principles to interpret ECG waves and suggest cardiac assist devices	Apply	1	1, 2, 5, 9,10, 12
3	Analyse the recording of neuro muscular signals	Analyze	1	1, 2, 3, 5, 9,10, 12
4	Design hardware and software tools/ methods to analyse biological signals	Creative	2	1, 2, 9, 10, 12
5	Evaluate the properties of biological samples using various medical analytical instrumentation.	Evaluate	2	1, 2, 9, 10

TEXT BOOKS:

1. Webster J.G., “Medical Instrumentation Application and Design”, 4th edition, Houghton Mifflin, 2015.
2. Khandpur R.S. “Hand Book of Biomedical Instrumentation”, 3rd edition, Tata McGraw-Hill, 2014.

REFERENCE BOOKS:

1. Carr and Brown, “Introduction to Biomedical Equipment Technology”,4th edition, Pearson, 2012.
2. Lurence J Street, “Introduction to Biomedical engineering technology”, 3rd edition, Taylor & Francis -Hill, 2016.
3. John Enderle, Susan M. Blanchard, and Joseph Bronzino, “Introduction to Biomedical Engineering”, 2nd edition, 2015.

SKILLS:

- ✓ *Study of biomedical instrumentation and their parameters.*
- ✓ *Study of different display devices.*
- ✓ *Determination of bio potentials and how they are interpreted.*
- ✓ *Extraction of biological signals and feeding them to instruments to make meaning out of it.*

https://www.shiksha.com /business-management -studies/articles /hospital-management-course-in-kolkata -blogId-68145

22BM205 HOSPITAL MANAGEMENT

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Basic Social studies.

COURSE DESCRIPTION AND OBJECTIVES:

This course provides a full introduction to the issues involved in the current practice of medical informatics. Major course topics address challenges related to the implementation of electronic health records and other medical and health care data bases in patient care settings, and their effective use in managing and improving personal and public health. The describe how the health care information infrastructure is used to collect, process, maintain, exchange, and disseminate data and demonstrate familiarity with information systems that employ communication and computer technology to collect, maintain, access, evaluate, and interpret health care / public health data.

MODULE-1

UNIT-1 **6L+6T+0P=12 Hours**

OVERVIEW OF HOSPITAL ADMINISTRATION:

Distinction between hospital and industry, Challenges in hospital administration, Hospital planning, Equipment planning, Functional planning, Current issues in hospital management, Telemedicine, Biomedical waste management.

UNIT-2 **10L+10T+0P=20 Hours**

HOSPITAL ORGANIZATION:

Organization of out-patient services, Problems encountered in functioning of O.P department, Organization of in-patient services - casualty; Emergency services – organization and management of operation theatres.

DEPARTMENTS IN HOSPITAL: Manpower planning, Different departments of hospital, Organization of ancillary services; Lab services - department of physiotherapy; Occupational therapy – organization of blood transfusion services; Department of radio diagnosis, Hospital pharmacy, Central sterilization and supply department, Food services, Laundry services.

PRACTICES:

- Design the Hospital and Equipment planning
- Evaluate the Biomedical waste management
- Evaluate the Different departments services

MODULE-2

UNIT-1 **8L+8T+0P=16 Hours**

HOSPITAL INFORMATION SYSTEMS AND HUMAN RESOURCE MANAGEMENT IN HOSPITAL:

Clinical information systems, Administrative information systems, Support service technical information systems, Medical transcription, Medical records department; Human resources management in hospital - management assisted by computers, reservation, admission, registration, discharge module.

UNIT-2 **8L+8T+0P=16 Hours**

QUALITY AND SAFETY ASPECTS IN HOSPITAL: 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 and managing health care, Medical audit, Hazard and safety in a hospital setup

PRACTICES:

- Select any designation in an organization and try to describe its job description and job specifications
- Analyze information system and support service system in various situations
- Practice problems with Quality Control charts

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the management practices to Plan and develop an effective hospital supportive system for all types of hospital services.	Apply	1	6,8, 9,10,12
2	Apply the hospital information system and human resource plaining in hospitals.	Apply	2	5, 8,9,10
3	Discriminate different quality and safety standards of hospitals.	Analyze	2	5,8, 9,10
4	Design and construct the hospital with an effective administration for all department services.	Creative	1	1, 2, 3, 5 ,6, 9, 10, 12
5	Evaluate the proper functioning and services provided by the hospitals.	Evaluate	2	3, 4, 5, 6, 9, 10

TEXT BOOKS:

1. D.K.Sharma, R.C. Goyal, “Hospital administration and Human resource management”, 7th edition, PHI, 2017.
2. G.D. Kunders, “Hospitals – Facilities Planning and Management”, 8th edition, TMH, Reprint 2017.

REFERENCE BOOKS:

1. Pansy Minett, “Handbook of Health Care Human Resources Management”, 2nd edition, Scitus Academics LLC, 2018.
2. Peter A.Berman “Health Sector Reform in Developing Countries”, Harvard University,Press,1995.
3. William A. Reinke “Health Planning for Effective Management”. Oxford University Press.2014
4. Blane, David, Brunner, “Health and Social Organization: Towards a Health Policy for the 21st Century”, 1st edition, Eric Calrendon Press, 2012.

SKILLS:

- ✓ *To be an expert in managerial skills*
- ✓ *Evaluation of different processes and improving them based on hospital requirements.*
- ✓ *Smooth operation of processes adhering to regulations and legislations.*
- ✓ *Study of quality control and other processes*
- ✓ *Able to maintain social relations*

https://www.mayo.edu / research/core-resourc-es/ biostatistics -core/ overview

22ST204 BIOSTATISTICS

Hours Per Week :

L	T	P	C
3	2	0	4

PRE-REQUISITE KNOWLEDGE: Basic mathematics.

COURSE DESCRIPTION AND OBJECTIVES:

This course is an introduction to statistical methods used in health, biological and medical sciences. The main objective of the course is to impart the knowledge about descriptive statistics and regression analysis performance characteristics of diagnostic tests. Along with the concepts of probability, testing of hypothesis, analysis of variance and design of experiments helps to analyse the practical situations through engineering applications.

MODULE- 2

UNIT-1 **9L+6T+0P =15 Hours**

DESCRIPTIVE STATISTICS AND CORRELATION ANALYSIS

Descriptive Statistics: Basic Definitions, Frequencies, Graphical Representation, Histogram, Ogive curves; Measures of Central tendency, Arithmetic mean, Median, Mode, Mean deviation, Standard deviation; Symmetry and Skewness.

Correlation Analysis: Karl Pearson's Coefficient of skewness. Covariance, Correlation, Types, Pearson's Coefficient of correlation, Rank correlation, Spearman's rank correlation.

UNIT-2 **5L+10T+0P = 22 Hours**

REGRESSION ANALYSIS AND PROBABILITY THEORY

Regression Analysis: introduction to Regression, regression coefficients, types of linear regression lines, construction of linear regression lines by least squared method and Properties.

Probability: Introduction, Definition (Classical and Axiomatic approach), Addition theorem, Conditional probability, Multiplication theorem and Bayes theorem.

PRACTICES:

- Draw various graphs for statistical data
- Identification of central value by averages
- Detection of data spreads and how the data is deviating from normal curve
- Measuring the statistical associations between two variables to know the type of relations and their strengths
- Constructing linear regression lines to find the unknown dependent variable value by giving known independent value
- Study the chance of occurrence random events

MODULE -2

UNIT-1 **9L+6T+0P = 15 Hours**

TESTING OF HYPOTHESIS

TESTING LARGE SAMPLES: Population, sample, statistic, parameter, level of significance, types of errors, critical region, testing of single mean, two means, single proportion and two proportions.

TESTING SMALL SAMPLES: Single mean, two means (independent and paired samples).

UNIT-2 **12L+8T+0P = 20 Hours**

ANALYSIS OF VARIANCE:

ANOVA: Assumptions, one-way classification, Two-way classifications with repetition and without repetition.

DESIGN OF EXPERIMENTS: Completely randomized design, Randomized complete block design. Chi square tests-goodness of fit and independence of attributes.

PRACTICES:

- Testing of samples significance by single mean and two means
- Testing of significance difference between proportions of two groups.
- Identification of one-way and two-ways classification of ANOVA
- Study of statistical significance difference on more than two groups
- Designing the statistical plan for various independent groups

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply basic statistical concepts commonly used in health sciences	Apply	1	1, 2
2	Use correlation and regression for the purpose of analysing the health population	Apply	1, 2	1,2 ,3
3	Measure the chance of random nature of events and calculate how the events will occurs	Evaluate	1	1, 2
4	Evaluate analysis results by testing hypothesis	Evaluate	2	1, 2, 4
5	Design the plan of statistical data to test the significance among the groups	Create	2	1, 2, 3 ,4

TEXT BOOKS:

1. K.Janarthan, P. Hanmantha Rao, “Fundamentals of Biostatistics”, Wiley Publications, 2019.
2. S.C. Gupta and V. K. Kapoor, “Fundamentals of Mathematical Statistics”, 7th Edition, Sultan Chand & Sons, 2017.

REFERENCE BOOKS:

1. Stanton A. Glantz, “Primer of biostatistics”, 7th edition, Mc Graw Hill, 2012.
2. Wayne W. Daniel, Chad L. Cross “Biostatistics: Basic concepts and methodology for the health sciences”, 10th edition, Wiley Publications, 2014.
3. P. R. Vittal, “Mathematical Statistics”, Margham Publications, Chennai, 2018.

SKILLS:

- ✓ *Organization of assorted data into meaningful information using statistical methods.*
- ✓ *Develop analytical capability to visualize data and give the pattern for data.*
- ✓ *Determination of various statistical procedures.*
- ✓ *Relations measuring*

Source: https://www.geeksforgeeks.org/best-way-to-start-with-competitive-programming-geeksforgeeks-cp-live-course/

22TP203 ADVANCED CODING COMPETENCY

Hours Per Week :

L	T	P	C
0	0	2	1

PREREQUISITE KNOWLEDGE: Programming in C, Data Structures.

COURSE DESCRIPTION AND OBJECTIVES:

This course helps to understand the impact of the choice of data structures and design strategies to solve the problem in an efficient manner. This course also provides the understanding of advanced graph applications and also throw light in tractable intractable problems.

MODULE-1

UNIT-1 **0L+0T+8P =8 Hours**

STACKS, QUEUES AND SINGLE LINKED LISTS:

PRACTICES:

Problems On Stacks & Queues

- Check if given stack of integers are consecutive or not (could be ascending or descending).
- Find the maximum sum in a sliding window using queues.
- Given a queue of integers, rearrange the elements by interleaving the first half with the second half.
- Given an integer k and a queue of integers, reverse the order of the first k elements of the queue.
- Given a maze in the form of a rectangular matrix filled with O, X or M where O represents an open cell, X represents a blocked cell and M represents landmines, find the shortest distance of every open cell in the maze from its nearest mine.
- For a given parenthesis expression, check whether it is balanced parenthesis or not.
- Reverse a number using stack.
- You are given a string s consisting of lowercase English letters. A duplicate removal consists of choosing two adjacent and equal letters and removing them. We repeatedly make duplicate removals on s until we no longer can.
- Find first Unique character in a string (Queue).
- Implement Tower of Hanoi problem.

Problems On Linked Lists

- Given a random pointer to a random node in a singly linked list, clone the list.
- Given a list rotate the list to the right by k places.
- Remove duplicates from a sorted list.
- Find fractional node in a singly linked list.
- Sort a linked list using constant space complexity.
- Delete a node in start, middle, end of Singly linked list.
- Add a node in start, middle, end of Singly linked list.
- Find whether given single linked list is circular or not.
- Arrange a singly linked list in Descending order.
- Addition of two numbers using Singly Linked List.

UNIT-2 **0L+0T+8P =8 Hours**

DOUBLY LINKED LISTS, CIRCULAR LINKED LISTS:

PRACTICES:

Problems on Double Linked Lists and Circular Linked Lists

- Implement a clockwise rotation of a doubly linked list by N places.
- Count triplets in a sorted doubly linked list whose product is equal to a given value x.
- Find the product of all prime nodes in a doubly linked list.
- Find the count of common nodes in two doubly linked lists.
- Find pairs with given product in a sorted doubly linked list.
- Delete all the even nodes of a circular singly linked list.
- Count nodes in a circular linked list.
- Delete all prime nodes from a circular singly linked list.
- Exchange first and last nodes in a circular linked list.
- Reverse a doubly circular linked list.
- Linear search using a stack of incomplete sub problems.
- 1 2 3 4 5 6 in stack S is push X is pop, SSSSXXSSSXXX.
- Recursively remove all adjacent duplicates.
- Check if a given singly linked list is a palindrome using stack.
- Convert a multilevel singly linked list to a singly linked list.
- Remove duplicates from an unsorted doubly linked list.
- Sort a doubly linked list using insertion sort.
- Check if a doubly linked list of characters is palindrome or not.
- Swap Kth node from beginning with Kth node from end in a Double Linked List.
- Convert a Binary Tree into Double Linked List.

MODULE-2

UNIT-1 **0L+0T+8P =8 Hours**

TREES:

PRACTICES:

Problems on Trees

- Given a sorted doubly linked list, convert it into a balanced BST.
- Given a singly linked list with data in the ascending order, convert it into a height balanced BST.
- Print the leaf to root path for every leaf node in a binary tree.
- Write a function to implement the reversed level order traversal of a binary tree.
- Truncate a given binary tree to remove nodes that lie on a path having sum less than K.
- Find the vertical sum in a given binary tree.
- Delete minimum & Maximum element from a BST.
- Implement Inorder, preorder and postorder tree traversal techniques.
- Print Kth largest element in a BST.
- Implement Zig-Zag tree traversal.

SKILLS:

- ✓ *Experienced to Store data and various types of data to handle.*
- ✓ *Ordering and sorting of data.*
- ✓ *Indexing and Searching of required data from large data sequences.*
- ✓ *Exposed to various characteristics such as Linear or non-linear, Homogeneous or heterogeneous and Static and Dynamic.*

UNIT-2 **0L+0T+8P =8 Hours**

GRAPHS:

PRACTICES:

Problems on Graphs

- Given a directed acyclic graph, determine whether there is a path that visits every vertex exactly once.
- Reverse a directed graph such that each edge from v to w is replaced by an edge from w to v.
- Find the shortest path in a graph that visits each vertex at least once, starting and ending at the same vertex.
- Find the minimum number of throws required to win a snake and ladder game.
- Implement DFS of a Graph.
- Implement BFS of a Graph.
- Detect whether a cycle is present in an undirected graph.
- Detect cycle in a Directed Graph.
- Find Shortest Distance to goal node from root node in a graph.
- Find no. of nodes in Kth level of a Graph.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply various data structures to solve a different algorithm.	Apply	1,2	1
2	Investigate the various data structures to solve a given problem in an efficient manner.	Analyse	1,2	2
3	Design and implement an appropriate hashing function for an application.	Create	1,2	4

TEXT BOOKS:

1. Reema Thareja, “Data Structures Using C”, 2nd Edition, Oxford University Press, 2014.
2. Seymour Lipschutz, “Data Structures with C”, 1st Edition, McGraw Hill Education, 2017.

REFERENCE BOOKS:

1. Ellis Horowitz and Sartaj Sahni, “Fundamentals of Data Structures”, illustrated edition, Computer Science Press, 2006.
2. Richard F. Gilberg and Behrouz A. Forouzan, “Data Structures: A Pseudocode Approach with C”, 2nd Edition, CENAGE Learning, 2005.
3. R G Dromey and Pearson, “How to solve it by Computer”, 2nd edition, Impression edition, 1998.

22BM206 ANALOG AND DIGITAL ICS

https://www.iis.fraunhofer.de /en/ff/sse/ic- design.html

Hours Per Week :

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Engineering Mathematics, Analog Electronic Circuits.

COURSE DESCRIPTION AND OBJECTIVES:

This course introduces the theoretical and circuit aspects of op-amp, timer, which are the backbone for the basics of linear integrated circuits and to understand the various linear and nonlinear applications of op-amp. Deals with fundamentals of number systems, boolean expressions which are used to realize combinational and sequential circuits with their logic families. Its objective is to introduce the concepts and techniques associated with the number systems and codes, to minimize the logical expressions using boolean postulates, to design various combinational and sequential circuits and to provide with a sufficient number of applications for the techniques and mathematics used in this course.

MODULE-1

UNIT-1 **6L+6T+6P=18 Hours**

INTRODUCTION TO LOGIC CIRCUITS & COMBINATIONAL LOGIC DESIGN:

Logic gates-NOT, AND, OR, NOR, NAND, XOR, XNOR, Truth tables, Boolean laws and theorems, Solving Boolean expressions, and logic circuits, The Karnaugh Map (up to four variables), Half adder, Half subtractor, Full adder, Full subtractor, Multiplexors and Demultiplexors, Decoders and encoders, Priority encoder.

UNIT-2 **10L+10T+10P=30 Hours**

SEQUENTIAL LOGIC DESIGN:

Concepts of Flip-flops – RS, D, T, JK flip flops and their conversions, Shift registers, SISO, PIPO, SIPO and PISO, Universal shift register, Synchronous and Asynchronous counters.

PRACTICES:

- Verification of logic gates with truth tables
- Half Adder and Full adder
- Multiplexor and demultiplexor using digital ICs
- Encoder and Decoders
- Flip Flops: SR, JK, D, T.
- Registers.
- Counters.

MODULE-2

UNIT-1 **8L+8T+8P=24 Hours**

OPERATIONAL AMPLIFIERS:

Basics of Op-amp, Ideal and Practical Characteristics- Slew rate, offset voltage, Bias current, CMRR, Bandwidth, Linear applications of op-amp- Inverting and non-inverting Summing amplifier, Nonlinear Applications-Differentiator, Integrator, Comparator, Schmitt Trigger, Active Filters.

SKILLS:

- ✓ *Minimize the logic functions using Boolean.*
- ✓ *Identify the different gates and their properties.*
- ✓ *Construct different combinational circuits.*
- ✓ *Design circuits using 555 timer IC for a different application.*
- ✓ *Verify the functionality of n-bit DACs.*

UNIT-2 **8L+8T+8P=24 Hours**

555 TIMER:

555 Timer IC (internal diagram) and its applications -Monostable multivibrator, A stable multivibrator.

PRACTICES:

- Opamp as inverting and non-inverting amplifier.
- Opamp as differentiator/ integrator
- Active filter – first order LPF and HPF
- 3-bit Binary R-2R ladder D/A converter
- 555 timer as astable multivibrator

COURSE OUTCOMES:

Upon successful completion of this course, students will have to ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the Boolean algebra to analyze combinational and sequential digital electronic circuits	Apply	1	1, 2, 9, 10, 12
2	Determine the characteristics and specifications of operational amplifiers	Analyze	1	1, 2, 5, 9, 10, 12
3	Analyze the operation of timer and its applications	Analyze	1	1, 2, 3, 5, 9,10, 12
4	Analyze operational amplifiers based circuits used for various applications	Analyze	2	1, 2, 5, 9, 10, 12
5	Evaluate digital circuits and some common electronic circuits using linear ICs and its applications.	Evaluate	2	1, 2, 3, 4 ,5, 9, 10, 12

TEXT BOOKS:

1. M. Morris Mano, “Digital Logic and Computer design”, e-book, pearson India, 2017.
2. Kumar, A. Anand, “Switching Theory and Logic Design”, e-book, PHI Learning Pvt. Ltd., 2014.

REFERENCE BOOKS:

1. Robert B.Northrop, “Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation”, 2nd edition, CRC Press, 2012.
2. Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”,1st edition, McGraw-Hills, 2015.
3. Millman J and Halkias C. “Integrated Electronics - Analog and Digital Circuit and Systems”, 2nd edition, TMH, 2017.
4. John. F. Wakerly, “Digital Design Principles and Practices”, 5th edition, Pearson Education,2018.
5. Charles H. Roth, Jr, “Fundamentals of Logic Design”, 4th edition, Jaico Books, 2015.

22BM303 BIOMATERIALS AND ARTIFICIAL ORGANS

https://www.mdpi.com /2076-3417/8/7 /1037/ htm

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Engineering Physics, Engineering Chemistry, Biochemistry.

COURSE DESCRIPTION AND OBJECTIVES:

This course aims at imparting the knowledge of material science, chemistry and characteristics and classification of biomaterials. It is useful to learn about different metals and ceramics used as biomaterials, polymeric materials and combinations for mechanism of tissue replacement implants and also gives knowledge of the artificial organ development.

MODULE–1

UNIT-1 **6L+0T+6P=12 Hours**

STRUCTURE OF BIO-MATERIALS AND BIO-COMPATIBILITY:

classification of biomaterials, Mechanical properties, Viscoelasticity, wound healing process, Body response to implants, Blood compatibility.

UNIT-2 **10L+0T+10P=20 Hours**

IMPLANT MATERIALS: Metallic implant materials, Stainless steels, Co based alloys, Ti-based alloys, Ceramic implant materials, Aluminium oxides, Hydroxyapatite, Glass ceramics, Carbons, Medical applications.

POLYMERIC IMPLANT MATERIALS: Polymerization, Polyamides, Acryrilic polymers, Biopolymers, Medical textiles silica, Chitosan, PLA composites, Sutures, Wound dressings; Materials for ophthalmology

PRACTICES:

- Biomaterial properties analysis
- Design an implants using the metals, metals alloys and polymers with simulation (COMSOL multi-physics)
- Analyze the Polymerization process and techniques suitable for different implants
- Implant materials analysis with respect to Size, Position, load and resection

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

TISSUE REPLACEMENT IMPLANTS:

Soft tissue replacements, Maxillofacial augmentation, Vascular grafts, Hard tissue replacement Implants.

UNIT-2 **8L+0T+8P=16 Hours**

ARTIFICIAL ORGANS:

Artificial blood, Artificial skin, Artificial heart, Prosthetic cardiac valves, Artificial pancreas, Dental implants.

PRACTICES:

- Hard tissue replacement analysis.
- Bone remodeling analysis.
- Hip replacement model analysis.

SKILLS:

- ✓ *Classification and investigation of suitable biomaterials*
- ✓ *Study various materials for biocompatibility.*
- ✓ *Analyzation of suitable biomaterials used for medical grafts*
- ✓ *Determine and selection of right materials for its bio applications.*
- ✓ *Apply specific design and quality control.*
- ✓ *Selection of the right materials for prostatics, implants or whole organs replacement with artificial organs.*

-
- Design of Musculoskeletal structure
- Design of dental implants.
- Design simulation and fabrication of artificial bone.
- Design simulation and fabrication of prostatic heart valves.
- Design simulation and fabrication of sensing elements (Heating aids, Intraocular lens)

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Classify biomaterials based on biocompatibility and mechanical properties	Analysis	1	1, 2, 9, 10
2	Identify suitable metals/ polymers for fabrication of wound dressings and implant/prostatics design.	Analyze	1	1, 2, 5, 9, 10
3	Differentiate the implant materials based on metal composition for different tissues.	Analyze	1	1, 2, 3, 5, 9, 10, 12
4	Determine the materials that are compatible for soft tissue and hard tissue replacements	Analyze	2	1, 2, 9, 10
5	Evaluate the suitability of artificial materials properties for replacement of organ functions	Evaluate	2	1, 2, 4, 5, 9, 10

TEXT BOOKS:

1. Joseph D. Bronzino," The Biomedical Engineering Hand Book, 5th Edition Boca Raton: CRC Press LLC, 2015.
2. John D. Enderle, "Introduction to Biomedical Engineering",4th edition, Academic Press, 2022.

REFERENCE BOOKS:

1. Ernesto Iadanza, "Clinical Engineering handbook",2nd edition, Academic Press, 2020.
2. A.C Anand, J F Kennedy, M. Miraftab, S.Rajendran, "Medical Textiles and Biomaterials for Healthcare", 2nd edition, CRC, 2016.
3.. M.Lysaght, T.J. Webster, "Biomaterials and Artificial organs",1st edition, woodhead publishing, Cambrige,2013.
4. William R Wagner, "Biomaterials Science: An Introduction to Materials in Medicine", Academic Press, 2nd edition, Narosa Publishing House, 2020.

22BM208 BIOMEDICAL SIGNALS AND SYSTEMS

https://ceme.nust.edu.pk/research / biomedical-signals -and-systems- bss-research-group/

Hours Per Week :

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Engineering Mathematics, Basic Electrical and Electronics Engineering.

COURSE DESCRIPTION AND OBJECTIVES:

This course explains the fundamental concepts of signal and systems and the various methods of classification. The methods for characterizing and analyzing continuous-time signals and systems will be the primary focus. Students will learn transform techniques (Laplace transform and Fourier transform) that will help them understand the biomedical instrumentation, physiological control systems, Biomedical signal processing, and medical image processing.

MODULE–1

UNIT-1 **6L+6T+6P=18 Hours**

CLASSIFICATION OF SIGNALS AND SYSTEMS:

Continuous and Discrete time signals, Standard signals – Step, Ramp, Pulse, Impulse, Sinusoidal, Exponential etc., Classification of CT and DT signals – periodic and A periodic signals, deterministic and random signals, energy and power signals, CT systems and DT systems, Classification of systems - static and dynamic, linear and nonlinear, time-variant and time invariant, causal and non-causal, stable and unstable.

UNIT-2 **10L+10T+10P=30 Hours**

LTI SYSTEMS:

Response of LTI system, Differential equation, Block diagram representation, Impulse response, Convolution Integrals, Convolution sum.

Fourier series: Representation of continuous-time periodic signals, convergence and properties of the Fourier series, complex Fourier spectrum.

PRACTICES:

- Use MATLAB to plot various signals.
- Determine whether the signal is an energy or power signal.
- Operation on signals (Folding, Shifting and Scaling) and plotting of trigonometric and exponential functions.
- Standard signal generation (Impulse, Step, Ramp and Sinc).
- Determine whether the system is Linear or nonlinear/Causal or non-causal/Static or dynamic/ Time invariant or time variant/ Stable or unstable.
- Plotting the amplitude spectrum and phase spectrum (using exponential Fourier series coefficients) for the periodic signal.

MODULE-2

UNIT-1 **8L+8T+8P=24 Hours**

ANALYSIS IN FREQUENCY DOMAIN

FOURIER TRANSFORM: Properties of the continuous-time Fourier transform, frequency response.

LAPLACE TRANSFORM: introduction to Laplace transform and region of convergence, properties of the Laplace transform, inverse Laplace transform, analysis of LTI systems using Laplace transform, Differential equation representation and solution.

SKILLS:

- ✓ *Design and test a LTI system.*
- ✓ *Choose the various transforms and their applications in the analysis of signals and systems.*
- ✓ *Apply transformation to real-world problems involving bio-signals.*
- ✓ *Analyze the abnormalities present in the physiological systems.*
- ✓ *Determine the quality of signals and improvement of them.*
- ✓ *Choose the desired sampling frequency for a given application.*

UNIT-2 **8L+8T+8P=24 Hours**

SAMPLING: Sampling theorem, Nyquist rate, Nyquist interval, Sampling of continuous time signals, Reconstruction of signal, Aliasing

PRACTICES:

- Compute and plot the Fourier transforms of arbitrary signals.
- Use the Fourier transform to compute (and plot) the convolution between the signals
- Compute and plot the frequency response of a system described by the impulse response.
- Compute the unilateral Laplace of arbitrary signals.
- A system is described by the impulse response . Compute the transfer function of the system.
- Sampling theorem verification, Reconstruction and Analysis of signals using MATLAB.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Outline the various properties and apply transform techniques on continuous time signals and systems.	Apply	1	1, 2, 9, 10
2	Apply the impulse response of an LTI system.	Apply	1, 2	1, 2, 5, 9, 10
3	Analyse the frequency spectrum of continuous time signals.	Analyze	1, 2	1, 2, 3, 5, 9, 10
4	Inspect sampling theorem.	Analyze	2	1, 2, 4, 5, 9, 10, 12
5	Evaluate the properties, magnitude/phase response of various signals and systems.	Evaluate	1, 2	1, 2, 3, 4, 5, 9, 10, 12

TEXT BOOKS:

1. Allan V. Oppenheim, S. Wilsky, S.H. Nawab, “Signals and Systems”, 3rd edition, Pearson, 2015.
2. B.P. Lathi and Roger Green, “Linear Systems and Signals,” Oxford University Press,3rd edition, 2020.

REFERENCES :

1. R.E.Zeimer, W.H.Tranter and R.D.Fannin, “Signals and Systems - Continuous and Discrete”, 4th edition, Pearson, 2017.
2. John Alan Stuller, “An Introduction to Signals and Systems”, 1st edition, Thomson, 2017.
3. M.J.Roberts, “Signals & Systems Analysis using Transform Methods and MATLAB”, 2nd edition, Tata McGraw Hill, 2017.
4. Hwei P. Hsu, “Schaum’s Outline of Signals and Systems”, McGraw-Hill Education,4th edition, 2020.
5. Luis F. Chaparro and Aydin Akan, “Signals and Systems using Matlab”, Academic Press, 3rd edition, 2019.

22TP204 PROFESSIONAL COMMUNICATION LABORATORY

Source: https://www.coursera.org/specializations/improve-english

Hours Per Week :

L	T	P	C
0	0	2	1

PREREQUISITE KNOWLEDGE: High School-level English.

COURSE DESCRIPTION AND OBJECTIVES:

To improve the overall professional communication skills (LSRW) of students and prepare them for their profession as engineers and managers. To provide them exposure to conventions of corporate communication and training them on how to function in the business world.

MODULE-1

UNIT-1 **0L+0T+8P=8 Hours**

BASICS OF BUSINESS WRITING SKILLS, PRACTICING BUSINESS CORRESPONDENCE AND REPORT WRITING:

Business English Vocabulary: Glossary of most commonly used words (formal and informal usage).

Elements of Technical Writing: Sentence structure, reducing verbosity, arranging ideas logically, building coherence, cohesive devices and transitional words.

Mechanics of Writing: Elementary rules of grammar, choice of diction, elementary principles of composition, matters of form, punctuation, conventions of business communication, language and professional tone, code of conduct (not sending illegal, offensive, disparaging personal remarks or comments) in written business communication.

Business Correspondence: E-mail: nature and scope, e-mail etiquette, clear call for action, common errors in composing e-mails, office communication such as meeting agenda and notice, circular and memo.

Letter-Writing: Formal and informal letters, structure of formal letters, expressions of salutations, different types of letters [such as sales letter, complaint letter, response to the complaint letter (dispute resolution), letter of permission, letter of enquiring, claim letter – letter of apology etc], introductory and concluding paragraphs and clear call for action.

Professional Proposal/Report: Differentiating proposals and reports, Drafting formal business proposals, types of reports such as factual reports, feasibility reports and survey reports, parts of a report (such as title page, declaration, acknowledgements, table of contents, abstract, introduction, findings, conclusion and recommendations).

New Age Corporate Communication Media: Importance of social media communication and Etiquettes, form and structure, sharing texts through Twitter, Whatsapp, instgram etc.

UNIT-2 **0L+0T+8P=8 Hours**

PRACTICING COMMUNICATIVE LANGUAGE IN VARIOUS PROFESSIONAL CONTEXTS:

Speaking: Speaking in business context, assertiveness, politeness, making requests, queries and questions, negotiations, asking for information, offering suggestions, conflict resolution, contacting clients, initiating, addressing delegates (in public), delivering the presentation effectively, telephone etiquettes, delivering seminar/proposal/report effectively, team meeting etiquettes (face to face and conference call), making effective one minute presentations(JAM) and participating in Group Discussions.

PRACTICES:

- Basic grammar practice, framing paragraphs on topics allocated, paraphrasing an article or a video in your own words, finding topic sentences in newspaper articles, finding out new words from a professional viewpoint and understanding the meaning and its usage.

SKILLS:

- ✓ *To enhance listening and spoken abilities of students needed for professional and social success in interpersonal situations, group interactions, and personal and professional presentations.*
- ✓ *Understand and practice specific functions and vocabulary in a business context.*
- ✓ *Produce short business reports, proposals and correspondence.*
- ✓ *Write various business documents through reading techniques.*

- Perusing samples of well-prepared business emails, memo, letter writing and short proposals and reports, students will draft business correspondence writing tasks and different proposals/ reports on topics assigned.
- Watching videos/listening to audios of business presentations, classroom activities of team and individual presentations, using PPTs, mock exercises for BEC speaking, agreeing, disagreeing politely, developing content, extended speaking in Group Discussion(s).

MODULE-2

UNIT-1 **0L+0T+8P=8 Hours**

READING AND COMPREHENDING BUSINESS DOCUMENTS:

Reading: Reading and comprehending business documents, learning business register, regularizing the habit of reading business news, suitable vocabulary, skimming and scanning a text for effective and speedy reading and dealing with ideas from different sectors of corporate world in different business contexts.

UNIT-2 **0L+0T+8P=8 Hours**

IMPARTING AND PRACTICING LISTENING SKILLS:

Listening: Specific information in business context, listening to telephonic conversations / messages and understanding the correct intended meaning, understanding the questions asked in interviews or in professional settings, summarizing speaker's opinion or suggestion, enable active listening.

PRACTICES:

- Hand-outs; matching the statements with texts, finding missing appropriate sentence in the text from multiple choices, using right vocabulary as per the given context and editing a paragraph.
- Working out BEC/TOEFL/IELTS listening exercises with hand-outs; matching the statements with texts, finding missing appropriate sentence in the text from multiple choice- multiple choices, using right vocabulary in context-editing a paragraph, listening to a long conversation such as an interview and answer MCQ s based upon listening.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Possess comprehensive skills in listening and reading business texts in formal context.	Apply	2	7
2	Communicate effectively both in their academic as well as professional environment.	Apply	2 &1	10
3	Clear grasp on the register of business language.	Analyze	1	8
4	Possess the ability to write business reports and proposals clearly and precisely to succeed in their future.	Create	1	12
5	Make effective presentations and participate in formal context.	Create	2	10

TEXT BOOK:

1. S. Schnurr, "Exploring Professional Communication: Language in Action", London: Routledge, 2013

REFERENCE BOOKS:

1. Brook Hart Guy, "Cambridge English Business Bench Mark: Upper Intermediate", 2nd Edition: CUP, 2014.
2. Cambridge University Publication, "Cambridge: BEC VANTAGE Practice Papers", CUP, 2002.
3. J. Seely, "The Oxford Guide to Effective Writing and Speaking", Oxford University Press, 2005.

III

YEAR

B.Tech.

BIOMEDICAL ENGINEERING

I SEMESTER

22BM301	-	Analog and Digital Communication
22BM302	-	Microprocessors and Microcontrollers
22BM303	-	Diagnostic and Therapeutic Equipments
22BM304	-	Biomechanics
	-	On-site training
	-	Open Elective – 2
22BM306	-	Inter-Disciplinary Project – Phase-I
22TP301	-	Soft Skills Lab
		NCC/ NSS/ SAC/ E-cell/ Student Mentoring/ Social activities/ Publication
		Minor / Honors – 2

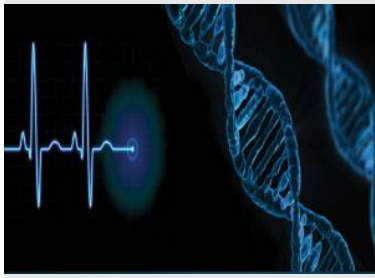
II SEMESTER

22TP302	-	Professional Communication
22BM307	-	Quantitative Aptitude and Logical Reasoning
22BM308	-	Digital Signal Processing
	-	Department Elective – 1
	-	Department Elective –2
	-	Open Elective – 3
22BM309	-	Industry interface course (Modular course)
22BM310	-	Inter-Disciplinary Project – Phase-II
	-	Minor / Honors – 3

COURSE CONTENTS

I SEM & II SEM

22BM301 ANALOG AND DIGITAL COMMUNICATION



ttps://elearning.reb.rw/course / view.php? id=341&section=10

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Analog and Digital Circuits.

COURSE DESCRIPTION AND OBJECTIVES:

This course covers the different types of analog and digital modulation techniques and its mathematical description, block-diagram system approach. Topics include the analysis amplitude modulation and demodulation, frequency modulation and demodulation, phase modulation and demodulation. Course topics are reinforced with computer simulation of analog communication systems. This course aims to give the basic mathematical concepts of two domain communications, the time domain and the frequency domain.

MODULE-1

UNIT-1 **6L+0T+6P=12 Hours**

Introduction to analog and digital communication, Historical background and applications.

AMPLITUDE MODULATION : need for modulation, Amplitude modulation (DSBFC) and demodulation virtues, Limitations, Modifications of AM, DSBSC modulation and demodulation, SSB modulation and demodulation, VSB modulation and demodulation, Power and efficiency calculations, Theme example.

UNIT-2 **10L+0T+10P=20 Hours**

ANGLE MODULATION: Basic definitions, Properties of angle modulated waves, Relationship between and FM waves, NBFM, WBFM, Transmission bandwidth of FM waves, Generation of FM waves, Demodulation of FM signals, Theme example.

PULSE MODULATION: Conversion of analog signal into digital signal by sampling process, Quantization and encoding, PAM, PCM, DPCM and Delta modulation, Theme examples.

PRACTICES:

- Amplitude modulation and demodulation.
- DSB-SC modulation and demodulation
- SSB-SC modulation and demodulation
- Frequency modulation and demodulation
- Pulse amplitude modulation and demodulation
- Sampling theorem verification

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

DIGITAL BAND-PASS MODULATION TECHNIQUES: Binary amplitude shift keying (BASK)- generation and detection; Binary phase shift-keying (BPSK) - generation and detection; Quadri phase shift keying (QPSK) - generation and detection, binary frequency shifts keying (BFSK), minimum shift keying (MSK); Differential phase shift keying (DPSK) - generation and detection, theme examples.

UNIT-2 **8L+0T+8P=16 Hours**

WIRELESS PERSONAL AREA NETWORKS (WPAN): Network architecture, WPAN components, WPAN technologies and protocols (Bluetooth and Zigbee), WPAN applications.

Wireless Wide Area Networks: Cellular networks - principles, GSM, CDMA, handover in cellular networks.

SKILLS:

- ✓ *Apply signal processing techniques in bio signal analysis.*
- ✓ *Convert analog bio signals to digital bio signals.*
- ✓ *Simulate an analyse various bio signals measured in the body.*
- ✓ *Efficiently design signal processing techniques for application specific biomedical*
- ✓ *equipment.*
- ✓ *Design simple AM modulator using discrete components.*
- ✓ *Design a VCO (NE 566) to generate FM signal for a given application.*
- ✓ *Design the scheme to capturing effect of FM receiver*

PRACTICES:

- Time division multiplexing.
- Frequency shift keying.
- Amplitude shift keying.
- Phase shift keying

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the analog to digital conversion techniques along with the pulse modulation techniques	Apply	1	1, 2, 9, 10
2	Analysis the different amplitude modulation techniques in communication systems. Infer the applications of WPAN, WWAN etc	Analysis	1	1, 2, 4, 5, 9, 10
3	Analyze the performance of different types of angle modulation techniques for a given set of parameters.	Analyze	1	1, 2, 4, 5, 9, 10, 12
4	Analyze the performance of digital modulation techniques.	Analyze	2	1, 2,4 9, 10, 12
5	Simulate and perform experiments on different types of analog and digital communication subsystems	Evaluate	2	1, 2, 3, 5 9, 10

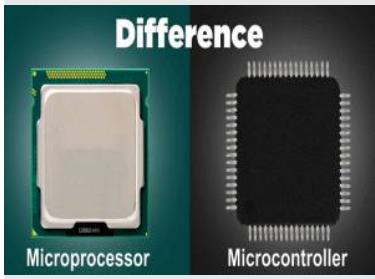
TEXT BOOKS:

1. B. P.Lathi, “Modern Analog and Digital Communication Systems”, 4th edition, Oxford University Press, 2017.
2. Wayne Tomasi, “Advanced Electronic Communication Systems”,6th edition, Pearson education, 2015.

REFERENCE BOOKS:

1. Simon Haykin, “Digital Communication Systems”, 4th edition, John Wiley & Sons, 2013.
2. Rappaport T. S, “Wireless Communications: Principles and Practice”, 4th edition, Pearson Education, 2014.
3. H.Taub, D L Schilling, G Saha,“Principles of Communication”, 4th edition, Pearson education, 2017.
4. Blake, “Electronic Communication Systems”, Thomson Delmar Publications, 2012.
5. B.Sklar, “Digital Communication Fundamentals and Applications” 2nd edition, Pearson Education, 2014.

22BM302 MICROPROCESSORS AND MICROCONTROLLERS



https://robu.in/what-is-the-difference-between-microprocessor-and-microcontroller/

Hours Per Week :

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Digital Electronics.

COURSE DESCRIPTION AND OBJECTIVES:

This course introduces basic architecture and operation of a microprocessor and a microcontroller to the student. The course objective is to study the architecture and addressing modes of 8086/8051 and to know the importance of different peripheral devices and their interfacing to 8086/ 8051 and ARM processors.

MODULE-1

UNIT-1 **6L+6T+6P=18 Hours**

8086 MICROPROCESSOR:

Evolution of microprocessors, 8086 microprocessor architecture, Register organization, Memory segmentation, Physical address calculation, addressing modes, Pin description of 8086, Instruction set.

UNIT-2 **10L+10T+10P=30 Hours**

8051 MICROCONTROLLER:

8051 microcontroller architecture, Internal and external memory organization, Pin diagram, addressing modes of 8051, Theory on Timers, Parallel ports and Serial communication, Interrupts of 8051, 8051 instruction set and assembly language programming, Example programs.

PRACTICES:

- Arithmetic and Logical operations operations using 8086
- Analyze different addressing modes of 8086.
- Program for sorting of given numbers
- Arithmetic and Logical operations operations using 8051
- Program to sort the array of numbers in ascending order.
- Programs to analyze different addressing modes of 8051
- Interfacing 7 segment LED display to 8051.
- Alphanumeric LCD panel interface to 8051
- DAC interface to 8051 for waveform generation.
- Stepper motor control interface to 8051

MODULE-2

UNIT-1 **8L+8T+8P=24 Hours**

ARM ARCHITECTURE:

RISC Vs CISC systems, ARM philosophy, ARM7TDMI core architecture, Programmer's model, ARM state register set, THUMB state register set, Current program status register, ARM 7TDMI operating modes, Mode bits, Exceptions, Interrupt vector table, Interrupt processing.

ARM INSTRUCTION SET: ARM assembly language, Instruction syntax, ARM Instruction set, Data processing, Branch, Load/Store Instructions, Miscellaneous instructions.

SKILLS:

- ✓ *Identify a Microcontroller for a specific application.*
- ✓ *Design a Micro-Processor based system.*
- ✓ *Design a Micro Controller based system.*
- ✓ *Do programming in assembly language.*
- ✓ *Design any micro controller based system with more than seven peripherals.*
- ✓ *Interface DAC*
- ✓ *Interface ADC*

UNIT-2 **8L+8T+8P=24 Hours**

APPLICATION IN MEDICINE:

Mobile phone based biosignal recording, Design of pulse oximeter circuit using ARM microcontroller, Design of heart rate monitoring circuit using ARM microcontroller.

PRACTICES:

- Introduction to Keil u-Vision 4 software
- 8-bit, 16-bit, 32-bit Arithmetic and Logical operations.
- Generation of waveforms using DAC with LPC2148.
- Blinking of LEDs with specific time delay
- Control the speed of DC/Stepper motor using LPC2148.
- Minor project based on the interest of students with LPC2148.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the acquired knowledge on ARM-7, their features and instruction set in programming the ARM processors.	Apply	1	1, 2, 9, 10, 12
2	Analyse the architectural features, on-chip system components of ARM-7 and ARM LPC2148.	Analyze	1	1, 2, 4, 5, 9, 10, 12
3	Create basic assembly language programs for 8086, 8051 and ARM processors.	Create	1	1, 2, 3, 5, 9, 10, 12
4	Create the resources of ARM LPC2148 and Cortex M3 to design ARM based embedded applications.	Create	2	1, 2, 9, 10, 12
5	Design a prototype of medical equipment application for acquiring skills in professional development.	Create	2	1, 2, 3, 5, 6, 9, 10, 12

TEXT BOOKS:

1. Mazidi “The 8051 Microcontroller and Embedded Systems using Assembly and C”,2nd edition, Pearson education, 2013.
2.. Kenneth J. Ayala, “The 8086 Microprocessor: Programming and Interfacing the PC”, 3rd Edition, Cengage Learning, 2014.

REFERENCE BOOKS:

1. Barry B. Brey, “The Intel microprocessors 8086/8088, 80186/80188, 80286, 80386,80486, Pentium, Pentium Pro processor, Pentium II, Pentium III, Pentium 4, and Core2 with 64-bit extensions: architecture, programming, and interfacing”, 8th edition, Pearson Prentice Hall, 2014.
2. Steve Furber, “ARM System on Chip Architecture”, 2nd edition, Pearson education, 2014.
3. William Hohe and Christopher Hinds, “ARM Assembly Language: Fundamentals and Techniques”, 2nd edition, CRC Press, 2015.
4. Yu Cheng Liu and Glenn, A Gibson, “Microcomputer Systems: The 8086/8088 family Architecture Programming and Design”, 2nd edition, Prentice Hall, 2015.
5. K. M. Bhurchandi and A. K. Ray, Advance Microprocessor and Peripherals, 3rd edition, Tata McGraw Hill, 2017.

22BM303 DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS

https://depositphotos.com /100760536/ stock-photo-advance -ultrasound-machine -in-hospital.html

Hours Per Week :

L	T	P	C
2	1	2	4

PREREQUISITE KNOWLEDGE: Analog circuits, Analog and linear ICs.

COURSE DESCRIPTION AND OBJECTIVES:

This course explains the concepts about human-instrument system and problems encountered in obtaining measurements from a living body. It also deals with basics of measuring the parameters in respiratory system, learn measurement techniques of sensory responses and understand different types and uses of diathermy units. It also gives knowledge of ultrasonic therapeutics and diagnosis.

MODULE–1

UNIT-1 **6L+3T+6P=15 Hours**

PATIENT MONITORING SYSTEMS:

Special care units, ICU/CCU equipments, Bed side patient monitoring systems – multi-parameters, measurement of heart rate and pulse rate, Holter monitor, phonocardiography, plethysmography, recording system; Oximeters -principle, intravascular oximeter; Cardiotacograph, Methods of monitoring foetal heart rate, Monitoring labour activity, Baby incubator.

UNIT-2 **10L+5T+10P=25 Hours**

DIATHERMY:

Short wave diathermy, Ultrasonic diathermy, Microwave diathermy, Electro surgery machine - current waveforms, tissue responses, electrosurgical current level, surgical diathermy analyzers, hazards and safety procedures.

AUTOMATED DRUG DELIVERY SYSTEMS:

Infusion pumps, Components of drug infusion pumps, Implantable infusion systems, Closed loop control in infusion systems, Programmable controlled insulin dosing device.

PRACTICES:

- Multipara meter monitoring system.
- Heart sound measurement using phonocardiography
- Design Cardiotacometer
- Design phonocardiography
- Design Patient monitoring system
- Shortwave diathermy
- Ultrasonic diathermy
- Long wave diathermy
- Inspection ESU – cutting and coagulation modes.
- Design syringe and Infusion Pumps

MODULE-2

UNIT-1 **8L+4T+8P=20 Hours**

EXTRA CORPOREAL DEVICES AND THERAPEUTIC TECHNIQUE:

Lithotripsy - Stone Disease Problem, First Lithotripter Machine, Modern Lithotripter Systems;

SKILLS:

- ✓ *Differentiate various instruments in hospitals for trouble shooting*
- ✓ *Determine diagnostic techniques used in health care.*
- ✓ *Investigate the breakdown of diagnostic and therapeutic equipments.*
- ✓ *Evaluate the procedures for safely carrying out therapeutic process*
- ✓ *Analyse the criticality of an instrument and trouble shoot it economically.*

Extracorporeal Shockwave Therapy, Principles of Cryogenic Technique and Application, Thermotherapy, Hyperthermia, High Intensity Focused Ultrasound (HIFU), Thermography – Recording and Clinical Application.

UNIT-2 **8L+4T+8P=20 Hours**

ELECTRICAL SAFETY:

Physiological effects of electricity, Importance susceptibility parameters, Distribution of electric power, Macro shock hazards, Microshock hazards, Electrical - safety codes and standards, protection against shock; Protection - electrical safety analyzers, testing electric system, tests of electric appliances, problems.

PRACTICES:

- Predict the thermal effects of tissue by operation of Hyperthermia through simulation
- Predict the thermal effects of tissue by operation of High intensity focused ultrasound therapy simulation
- Electrical safety measurements
- Examine the Protection of electrical safety issue of instruments

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Classify critical equipment into various units	Analyze	1	1, 2
2	Distinguish the different diathermy equipment by applying physics laws and Evaluate the diathermy units to estimate the treatment plans.	Analyze	1	1, 2, 4, 9, 10
3	Design the components and working of drug delivery systems	Analyze	1	1, 2, 3, 4, 5, 9 ,10
4	Apply ultrasound physics to realize the treatment of kidney stones, cancer	Apply	2	1, 2, 5 ,6
5	Evaluate the electrical safely carrying out therapeutic devices in hospitals	Evaluate	2	1, 2, 6, 9, 10

TEXT BOOKS:

1. Khandpur R.S, “Handbook of Biomedical Instrumentation”, 3rd edition, Tata McGraw Hill, 2014.
2. Leslie Cromwell, “Biomedical Instrumentation and Measurement”, 4rd edition, Prentice Hall, 2015.

REFERENCES :

1. John G. Webster, “Medical Instrumentation Application and Design”, 4th edition, John Willey and Sons, 2015.
2. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”,4th edition, Pearson Education, 2014.
3. L.A Geddas and L.E.Baker, “Principles of Applied Biomedical Instrumentation”, 3rd edition, 2017.
4. Myer Kutz “Standard Handbook of Biomedical Engineering and Design”, McGraw-Hill Publisher, 2013.

22BM304 BIOMECHANICS

https://pdhpe.net/ the-body-in-motion/how- do-biomechanical-principles-influence-movement/

Hours Per Week :

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Engineering Physics.

COURSE DESCRIPTION AND OBJECTIVES:

The course provides an overview of musculoskeletal anatomy, the mechanical properties and structural behaviour of biological tissues, and biodynamics. Specific course topics include structure and functional relationships in tissues and organs; application of stress and strain analysis to biological tissues; analysis of forces in human function and movement; energy and power in human activity. The course is meant to provide basic background in biomechanics for engineering students considering medical school, industrial positions in the biomedical field.

MODULE-1

UNIT-1 **6L+6T+6P=18 Hours**

INTRODUCTION TO MECHANICS:

Principles of mechanics, Vector mechanics, Mechanics of motion Newton's laws of motion, Kinetics, Kinematics of motion, Basic fluid mechanics – Euler equations, viscoelasticity, constitutive equations, stress transformations, strain energy function.

UNIT-2 **10L+10T+10P=30 Hours**

BIOFLUID MECHANICS:

Introduction, Viscosity and capillary viscometer, Rheological properties of blood, Laminar flow, Couette flow and Hagen-poiseuille equation, Turbulent flow; Cardiovascular system - biological and mechanical valves development, testing of valves; Structure, Functions, Material properties and modeling of blood vessels.

BIOSOLID MECHANICS: Hard Tissues - bone structure and composition mechanical properties of bone, cortical and cancellous bones, viscoelastic properties, Maxwell and voight models, anisotropy; Soft tissues - structure, functions; Material properties and modeling of soft tissues - cartilage, tendon, ligament, muscle.

PRACTICES:

- Demonstration of Bernoulli's principle
- Design and simulation of blood flow analysis of human aorta
- Design and modeling of blood vessel and micro vessels
- Analyse mechanical properties of metal rod, bone, muscle, tendon

MODULE-2

UNIT-1 **8L+8T+8P=24 Hours**

BIOMECHANICS OF JOINTS AND IMPLANTS:

Skeletal joints, Forces and stresses in human joints, Analysis of rigid bodies in equilibrium, Free body diagrams, Types of joint, Biomechanical analysis of Shoulder, Hip, knee and Ankle; Design of orthopaedic implant, Specifications for a prosthetic joint, Manufacturing process of implants, Fixation of implants.

SKILLS:

- ✓ *Analysis of laws of mechanics for bio mechanics.*
- ✓ *Determination of types of flows in vessels.*
- ✓ *Analyze physics behind tissues, bones, structures.*
- ✓ *Analysis of movement and other motion in humans.*
- ✓ *Medical implants processing and manufacturing.*
- ✓ *Analysis of blood vessels based on various laws of structures.*

UNIT-2 **8L+8T+8P=24 Hours**

MODELLING AND ERGONOMICS:

Introduction to finite element analysis, Analysis of bio mechanical systems using finite element methods - femur implant fixation, graphical design; Ergonomics – gait analysis, design of workstation, sports biomechanics, injury mechanics.

PRACTICES:

- Biomechanical analysis of Shoulder, Hip, knee and Ankle
- Analysis of biomechanical properties of Femur- implant fixation
- Design the modeling of bone
- Design the modeling of tendon
- Design the modeling of muscle.
- Design of orthopedic implant
- Gait analysis

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply mechanical forces to joints and derive the basic constitutive equations for solid and liquid bio elements	Apply	1	1, 2, 9, 10, 12
2	Analyse properties of structures and functions to human joints for normal and diseased	Analyze	1	1, 2, 4, 5, 9, 10
3	Derive the equations of fluids for estimating pressures in a vessel.	Creative	1	1, 2, 3, 5, 9, 10, 12
4	Analyse static and dynamic gait postures for analysing kinematic data.	Analyze	2	1, 2, 4, 5, 9, 10, 12
5	Evaluate the properties and forces acting on human joints.	Evaluate	2	1, 2, 5, 9, 10

TEXT BOOKS:

1. Nihat Özkaya, Margareta Nordin, David Goldsheyder, Dawn Leger, “Fundamentals of Biomechanics”, 3rd edition, Springer Science and Business Media, 2012.
2. R.S. Khurmi, “A text book of Engineering Mechanics”, 20th edition, S. Chang, 2014.

REFERENCE BOOKS:

1. Marcelo Epstein, “The Elements of Continuum Biomechanics”, WIley,2012.
2. Pamela K. Levangie, Cynthia C. Norkin, “Joint Structure and function: A comprehensive analysis”, 6th edition F.A. Davis Company, 2019.
3. Jay D. Humphrey and Sherry De Lange, “An Introduction to Biomechanics: Solids and Fluids, Analysis and Design”, 2nd edition, Springer Science and Business Media, 2015.
2. Pamela K. Levangie, Cynthia C. Norkin, “Joint Structure and function: A comprehensive analysis”, 6th edition F.A. Davis Company, 2019.
3. Jay D. Humphrey and Sherry De Lange, “An Introduction to Biomechanics: Solids and Fluids, Analysis and Design”, 2nd edition, Springer Science and Business Media, 2015.

22TP301 SOFT SKILLS LABORATORY

Source: https://choosework.ssa.gov/blog/2019-07-23-soft-skills-an-intro-to-effective-communication

Hours Per Week :

L	T	P	C
0	0	2	1

PREREQUISITE KNOWLEDGE: Grasp on their own academic achievements.

COURSE DESCRIPTION AND OBJECTIVES:

To impart employability skills like resume preparation and facing interviews. To enable trainees to develop interpersonal and leadership skills and to train them on work place skills like making presentations, participating in group discussions etc.

MODULE-1

UNIT-1 **0L+0T+8P=8 Hours**

PERSONALITY DEVELOPMENT:

Soft Skills: Need for soft skills, professionalism, employability skills; Communication: Need for effective communication - the process of communication, levels of communication, flow of communication, choice of diction and style with reference to setting (formal, semi-formal or informal); communication networks, barriers to communication, miscommunication, noise and ways to overcome the barriers; Career Planning: Job vs. career, SWOT analysis.

UNIT-2 **0L+0T+8P=8 Hours**

LANGUAGE AND VOCABULARY:

Vocabulary Building: Word etymology, roots, prefixes & suffixes, synonyms & antonyms, collocations, one-word substitutes, analogies, idioms and phrases, contextual guessing of unfamiliar words, task-oriented learning; Reflection of language on Personality, Gender sensitive language in MNCs, Mind your language, Seven essential skills for a team player; attentive listening, intelligent questioning, gently persuading, respecting other's views, assisting others, sharing, participating actively.

PRACTICES:

- Self-Introduction.
- Personal and Academic SWOC.
- Johari Window.
- Giving and taking opinions of Self Vs others and assessing oneself.
- Goal setting.
- Short, Mid and Long Term goals planning the semester.
- Time management: four quadrant system.
- Stephen Covey Time Management Matrix planning a semester.
- Stress-management.
- Questionnaire to assess level of stress.
- 50 words towards resume preparation and interviews.
- Newly coined words.
- Gender sensitive words and Words acceptable in Indian context and objectionable international context.

MODULE-2

UNIT-1 **0L+0T+8P=8 Hours**

LANGUAGE IN ACTION:

Functional English: Situational dialogues, Role plays (including small talk); Group Discussion: Articulation and flow of oral presentation, dynamics of group discussion, intervention, summarizing and conclusion, voice modulation, content generation, Key Word Approach (KWA), Social, Political, Economic, Legal

SKILLS:

- ✓ *Balance social and emotional intelligence quotients though SWOC, JOHARI etc. activities.*
- ✓ *Prepare tailor made resume and face various job interviews with enriched personality traits.*
- ✓ *Career planning with clear personal and professional goals.*
- ✓ *Solve personal and professional life hiccups with confidence and maturity.*

and Technical Approach (SPELT), View Point of Affected Part (VAP), language relevance, fluency and coherence – 11th and 12th weeks; Resume preparation: Structure and presentation, defining career objective, projecting one's strengths and skill-sets, summarizing, formats and styles and covering letter-Statement of Purpose.

UNIT-2 **0L+0T+8P=8 Hours**

PREPARING FOR PRESENTATIONS AND INTERVIEWS:

Facing Interviews: Interview process, understanding employer expectations, pre-interview planning, opening strategies, impressive self-introduction, answering strategies, other critical aspects such as body language, grooming, other types of interviews such as stress-based interviews, tele- interviews, video interviews, frequently asked questions (FAQs) including behavioral and HR questions and the aspect looked at by corporate during interviews; Presentation Skills: Selection of a topic, preparing an abstract, gathering information, organizing the information, drafting the paper, citing reference sources – writing striking introductions, discussing the methodology used, developing the argument, presentation style, language, presenting the paper and spontaneously answering audience questions.

PRACTICES:

- Opening and closing a telephonic conversation.
- Making an appointment.
- Making a query.
- Offering/Passing on information.
- Communicating with superiors.
- Expressing agreement/objection.
- Opening bank account (combination of prepared and impromptu situations given to each student).
- Group Discussions on various topics.
- Preparing SoP and Resume.
- Mock interviews on the FAQs including feedback.
- Oral presentation with the help of technology (Preparing PPT and presenting).

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Mod-ule No.	Mapping with POs
1	Have the ability to introspect on individual strengths and weaknesses, and emerge as a balanced personality with improved self-awareness and self-worth .	Apply	1	12
2	Observe gender sensitive language and workplace etiquette in his professional life.	Analyze	1	9
3	Be able to prepare a resume and gain the confidence to face an interview.	Create	1&2	10
4	Possess the interpersonal skills to conduct himself/herself effectively in everyday professional and social contexts.	Apply	2	8
5	Bring professionalism into his/her daily activities.	Create	2	8

TEXT BOOKS:

1. Adrian Furnham, "Personality and intelligence at work", Psychology Press, 2008.
2. S. P. Dhanvel, "English and Soft skills", Orient Blackswan, 2011.

REFERENCE BOOKS:

1. Edward Holffman, "Ace the corporate personality", McGraw Hill, 2001.
2. John Adair Kegan Page, "Leadership for innovation", Kogan, 2007.
3. Krishna Mohan & NP Singh, "Speaking English effectively", Macmillan, 2008.
4. Rajiv K. Mishra, "Personality Development", Rupa & Co. 2004.

22TP302 QUANTITATIVE APTITUDE & LOGICAL REASONING

Source: https://images.app.goo.gl/kvtVgA8TkvDCqLhj7

Hours Per Week :

L	T	P	C
1	2	0	2

PREREQUISITE KNOWLEDGE: Basic Logical Thinking and Problem Solving Ability.

COURSE DESCRIPTION AND OBJECTIVES:

The Students will be introduced to various Arithmetic and Reasoning Problems. The students will have acquaintance with various problems like Time & Work, Time & distance, Percentages, Profit & Loss etc. besides solving puzzles and Critical Reasoning.

MODULE-1

UNIT-1 **4L+8T+0P=12 Hours**

Number system, LCM & HCF of numbers, Percentage, Ratio and proportion, Profit, loss and discount, Average & Mixtures, Simple Interest & Compound interest.

UNIT-2 **4L+8T+0P=12 Hours**

Time and work, Time & distance, Problems on trains, Problems on ages, Permutation & Combinations, Probability.

PRACTICES:

- Each concept would be taught in detail in the class followed by 10 problems solved in the class. Students would have to solve 10 additional problems as homework assignment in each concept.

MODULE-2

UNIT-1 **4L+8T+0P=12 Hours**

Number series, Letter series, Analogy, Odd man out, Coding and decoding, Syllogisms- Statement & Conclusions, Puzzle test.

UNIT-2 **4L+8T+0P=12 Hours**

Blood relations, Direction sense test, Order & Ranking, Seating Arrangements, Calendar & Clocks.

PRACTICES:

- Each concept would be taught in detail in the class followed by 10 problems solved in the class. Students would have to solve 10 additional problems as home work assignment in each concept.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Meet the demands of current job market besides equipping them higher studies like CAT, GMAT etc.	Apply	1	2, 5
2	Solve Arithmetic and Reasoning Problems within shortest possible time without paper work.	Apply	1	2, 5
3	Exhibit better analytical skills and aptitude skills.	Analyse	2	2, 4
4	Develop interpretational skills.	Evalua-tion	2	2, 4

SKILLS:

- ✓ *Helps in developing and improving problem solving skills*
- ✓ *Allow students to develop critical thinking skills*

TEXT BOOKS:

1. R. S. Aggarwal- Quantitative Aptitude for Competitive Examinations- S. CHAND Publications- Revised Edition-2017.
2. ARIHANT- A New Approach To Verbal & Non-Verbal Reasoning- Arihant Publication- Revised Edition-2021.

REFERENCE BOOKS:

1. Trishna Knowledge Systems- Quantitative Aptitude for Competitive Examinations- Pearson Publication- First Edition- 2013.
2. R. S. Aggarwal- A Modern Approach to Verbal & Non-Verbal Reasoning-S. CHAND Publications- Revised Edition-2018.

22BM307 BIOMEDICAL SIGNAL PROCESSING

https://usharama.edu.in /blogDetail/biomedical-signal-processing

Hours Per Week :

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Signals and Systems.

COURSE DESCRIPTION AND OBJECTIVES:

This course presents relationships among different theoretical measures of biomedical signals and an understanding of the information. Biomedical engineering involves the application of engineering methods for the improvement of human health; the signals encountered by biomedical engineers are typically derived from biological processes. This course imparts the knowledge of signal processing of all bio-potentials and their corresponding transforms.

MODULE-1

UNIT-1 **10L+10T+10P=30 Hours**

FUNDAMENTALS OF DISCRETE-TIME SIGNALS AND SYSTEMS:

Concepts of systems and signal, Z-transform, Discrete Fourier transform (DFT), Fast Fourier transform(FFT), Medical applications.

BIOMEDICAL SIGNAL:

Biomedical signal origin, Dynamics ECG, EEG, EMG signal and its characteristics, Filtering for removal of artifacts; Statistical preliminaries - random noise, structured noise, stationary vs non stationary processes; Time domain filtering (synchronized averaging, moving average).

UNIT-2 **6L+6T+6P=18 Hours**

ELECTROCARDIOGRAM (ECG):

Heart rhythms, Heart beat morphologies, Noise and artifacts, Base line wander, Power line interference, Muscle noise filtering, QRS detection, Wave delineation, Data compression, Heart rate variability, Spectral analysis of heart rate variability.

PRACTICES:

- Find the output y(n) for an input x(n), for the discrete time system represented by impulse response h(n).
- Compute Linear Convolution and circular for two sequences.
- Compute the Discrete Fourier Transform and IDFT with and without FFT and IFFT
- Implementation of Decimation-in-time / Decimation-in-frequency radix-2 FFT algorithm.
- Find the Fourier transform, frequency response of x(n), and plot its magnitude and phase.
- Compute the Discrete Fourier Transform and IDFT with and without FFT and IFFT.
- Data polishing removal of power line interface from ECG
- Display static and moving ECG signal
- Spectrum analysis of ECG Signals.
- Detect QRS complex and measure the heart rate of a given ECG signal

MODULE-2

UNIT-1 **8L+8T+0P=16 Hours**

ELECTROENCEPHALOGRAM(EEG):

Applications, Modeling - deterministic and stochastic properties, linear, stochastic models, nonlinear

SKILLS:

- ✓ *Analyze different biopotential signals using Lab View/MATLAB.*
- ✓ *Test and design a stable system (ECG, EMG, EEG kit).*
- ✓ *By deeply understating the physiological signals and systems can design different*
- ✓ *vital monitoring systems.*
- ✓ *Waveform analysis of ECG, EEG, and EMG*

modeling of the EEG; Artifacts - artifacts characteristics, artifact cancellation using linearly combined reference signals, adaptive artifact cancellation using linearly combined reference signals; Noise reduction by ensemble averaging, Nonparametric and model based spectral analysis, EEG segmentation, Evoked potential modalities.

UNIT-2 **8L+8T+0P=16 Hours**

ELECTROMYOGRAM (EMG):

The electrical activity of muscles, Amplitude estimation in the surface EMG, Spectral analysis of the surface EMG, Conduction velocity estimation, Modeling the EMG, EMG signal decomposition.

PRACTICES:

- Classification of EEG signals and analysis.
- Detection of EEG rhythms, Template matching for EEG, spike and wave detection
- Removal of Artifacts in the EEG
- Removal of Artifacts in the EMG
- EEG rhythms, waves, and transients
- Analysis of EMG Signals

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply basic concepts of discrete time biomedical signals and systems	Apply	1	1, 2, 9, 10
2	Apply filters and averaging techniques to remove noise and extract features of biomedical signals, also to evaluate performance of algorithms	Apply	1	1, 2, 4
3	Develop simple algorithms and Evaluate performance of ECG, EMG and EEG that will serve the basis in career	Create	1	1, 2, 3, 5, 9, 10, 12
4	Analyze the biomedical signals ECG, EMG and EEG and its interpret the nature	Analyze	2	1, 2, 4, 9, 10, 12
5	Verify various transform techniques and filters and evaluate the physiological signals by applying signal processing techniques using Matlab.	Evaluate	2	1, 2, 4, 5, 9, 10

TEXT BOOKS:

1. N.Vyas, “Biomedical Signal Processing”, University Science Press, New Delhi, 2014.
2. Rangaraj M. Rangayyan, Akay Metin (Editor), “Biomedical Signal processing”, 1st edition, IEEE Press, 2014.

REFERENCE BOOKS:

1. Leif Sornmo and Pablo Laguna, “Bioelectrical Signal Processing in Cardiac and Neurological Applications”, 3rd edition, Academic Press, 2005.
2. Mahesh Kumar H.Kolekar, “Biomedical Signal and Image Processing in patient care ”, IG Globl, 2017.
3. Ganesh Naik, “ Biomedical Signal Processing- Advances in theory, Algorithms and Applications, Springer,2020.

22BM308 MEDICAL IMAGING MODALITIES

https://openmedscience.com/medical-imaging/

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Engineering Physics, signals and systems, Biomedical Instrumentation.

COURSE DESCRIPTION AND OBJECTIVES:

This course studies the image reconstruction techniques, quality assurance test for radiography, method of recording sectional image, functioning of radioisotopic imaging equipment and the MRI, image acquisition and reconstruction, it also explains the 3-D image display techniques. This course aimed at imparting knowledge of operation and medical applications of the major medical imaging techniques.

MODULE –1

UNIT-1 **6L+6T+0P=12 Hours**

INTRODUCTION:

X-ray, CT, Ultrasound, MRI, PET-CT, SPECT-CT, Gamma Camera, Catheterization Lab. Image perception, Image acquisition, Display, Image processing operations, scanning.

X-RAY: X-Ray imaging, Fundamentals of X-ray, Electromagnetic radiation, Interactions between X-rays and matter, Intensity of X-ray beam, Attenuation, Generation and detection of X-rays, biological effects of ionizing radiation; X-Ray diagnostic methods - conventional X-ray radiography, fluoroscopy, angiography, mammography and xeroradiography.

CT: Conventional tomography, Computed tomography - projection function, algorithms for image reconstruction, multiplanar reconstruction, non-spiral CT technology, concepts of spiral CT scanner, multi slice spiral technology, Recent applications – CT angio, cardiac CT, dual energy CT.

UNIT-2 **10L+10T+0P=20 Hours**

ULTRASOUND IMAGING:

Fundamentals of acoustic propagation - characteristic impedance, intensity, reflection and refraction, attenuation, Doppler effect; Generation and detection of Ultrasound - piezoelectric effect, ultrasonic transducers.

ULTRASONIC DIAGNOSTIC METHODS:

Pulse echo systems - amplitude mode (A-mode), brightness mode (B-mode), motion mode (M-mode), 3D, 4D, Doppler methods, duplex imaging, colour Doppler flow imaging, image artifact, biological effects of ultrasound.

PRACTICES:

- Analyse the radiation exposure to patients by using low kV values
- Evaluate the prevention of unnecessary exposure to patients in digital radiography
- Evaluate the rejection analysis in radiography reduce unnecessary exposure to patients
- Determines the Quality of the chemical processing of radiographic film have any effect on the radiation exposure of a patient
- Determines the radiation dose to the breast of patients in mammography
- Determines the radiation exposure to a patient affected by the size of the image (area covered by the X-ray beam)
- Apply the reconstruction techniques of the CT images for generation of image
- Analysis the radiation doses to patients undergoing cardiac CT procedures compare to doses from other radiographic procedures
- Design and Develop the ultrasound transducer
- Determines the ultrasound modes for examine the diseases

SKILLS:

- ✓ *Study the physics behind medical imaging.*
- ✓ *Determine the basis for an image is formation.*
- ✓ *Know the image formation in MRI.*
- ✓ *Grasp the knowledge of CT and importance of a medical department.*
- ✓ *Image acquisition and processing of images for required model.*

MODULE-2

UNIT-1 **8L+8T+0P=16 Hours**

MAGNETIC RESONANCE IMAGING: Basics of magnetic resonance imaging, Fundamentals of nuclear magnetic resonance - angular momentum, magnetic dipole moment, magnetization, larmour frequency, free induction decay (FID), Fourier spectrum of the NMR signal, spin density, relaxation times, pulse sequences.

MRI SYSTEM & IMAGING METHODS: Introduction, Magnet, NMR Coil/Probe, Transmitter, Receiver, Data acquisition; Imaging methods - introduction, slice selection, frequency encoding, phase encoding, spin-echo imaging, gradient echo imaging; Characteristics of MRI images - spatial resolution, image contrast, biological effects of magnetic fields, static magnetic fields, radiofrequency fields, gradient magnetic fields, imaging safety, functional MRI (brief introduction only).

UNIT-2 **8L+8T+0P=16 Hours**

NUCLEAR IMAGING: Physics of gamma camera, Basic instrumentation, Imaging techniques, SPECT and whole body studies; Applications of gamma camera in cardiology, Nephrology, Neurology etc., PET - fundamentals of PET scanner and PET- CT, crystal technology, cyclotron principle, Applications of PET - cardiology, neurology and cardiology.

PRACTICES:

- Analysis the MRI compare with doses from other examinations.
- Determine the reconstruction techniques of the MRI images for generation of image
- Analysis the PET/CT radiation doses compare with doses from other examinations.
- Determine the patient exposure PET/CT radiation given in an examination
- Determine the optimize image quality in a gamma camera examination
- Determine the optimization in diagnostic nuclear medicine

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyse the CT image reconstruction techniques using different algorithms.	Analyze	1	1, 2, 5, 9, 10
2	Apply the concepts of ultrasound image formation model and analyse the biological effects	Apply	1	1, 2, 5, 9, 10
3	Apply MRI pulse sequences & hardware systems for tissues imaging and its hardware	Apply	1	1, 2, 3, 5, 9, 10
4	Analyse the nuclear spins and the decay systems of NMR	Analyze	2	1, 2, 4, 5, 9, 10, 12
5	Analyse the SPECT- PET imaging formation techniques in cardiology and neurology.	Analyze	2	1, 2, 4, 5, 9, 10, 12

TEXT BOOKS:

1. Kirk Shung, Michael B. Smith and Banjamin Tsui, “Principles of Medical Imaging”, Academic Press, 2015.
2. Paul Suetens, “Fundamentals of Medical Imaging”, 3rd edition, Cambridge University Press, 2017.

REFERENCE BOOKS:

1. Michael Chappell, “Principles of Medical Imaging for Engineers”, Springer, 2019.
2. Stewart C.Bushong,Geoffrey Clarke “Magnetic Resonance imaging –physical and Biological principles”, Elsvier, 4th edition,2014.
3. Hykes, Heorick, Starchman, “Ultrasound physics and Instrumentation”, MOSBY, 6th edition, 2021.
4. Russell K Hobbie, Bradley J Roth, “Intermediate physics for Medicine for Biology, Springer, New York, 4th edition, 2013.

IV

YEAR

BIOMEDICAL ENGINEERING

B.Tech.

I SEMESTER

- 22BM401 - Biosensors and Transducers
- 22BM402 - Medical Image Processing
- - Department Elective – 3
- - Department Elective – 4
- - Department Elective – 5
- - Department Elective – 6
- - Minor / Honors – 4

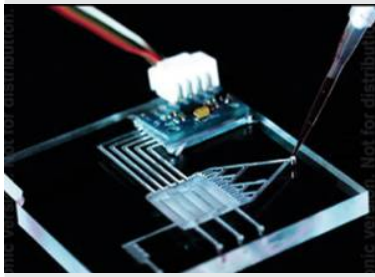
II SEMESTER

- 22BM403 - Project Work
- 22BM404 - Internship
- - Minor / Honors – 5 (for Project)

COURSE CONTENTS

I SEM & II SEM

22BM401 BIOSENSORS AND TRANSDUCERS



https://www.sensorsportal.com/HTML/DIGEST/Digest_Apr_May_2018.htm

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Engineering Physics, Analog Electronic Circuits.

COURSE DESCRIPTION AND OBJECTIVES:

This course imports the knowledge of classification and descriptions of transducers, survey of possible energy conversions. This course is useful to learn the purpose of measurement, the methods of measurements, errors associated with measurements and to know the principle of transduction, classifications and the characteristics of different transducers and study its biomedical applications.

MODULE-1

UNIT-1 **6L+0T+6P=12 Hours**

SCIENCE OF MEASUREMENT:

Measurement system, Instrumentation, Classification and characteristics of transducers, Static and dynamic, Errors in measurements, Calibration, Primary and secondary standards, Strain gauge- gauge factor, Sensing elements, Configuration, Unbounded strain gage, Biomedical applications.

UNIT-2 **10L+10T+0P=20 Hours**

DISPLACEMENT, PRESSURE AND TEMPERATURE SENSORS:

Strain gauge as displacement and pressure transducers, Capacitive transducer, Inductive transducer, LVDT; Passive types: RTD materials and range, Relative resistance vs temperature characteristics, Thermistor characteristics, Biomedical applications of temperature sensors; Active type, Thermocouple, Characteristics, AC and DC bridges, Wheat stone bridge, Kelvin, Maxwell, Hay, Schering.

PRACTICES:

- Displacement using LVDT
- Distance using LDR.
- Temperature using R.T.D/Thermocouple
- Pressure using strain gauge.
- Pressure using piezo-electric pick up
- Distance using capacitive pick up.
- Speed of DC motor using magnetic and photo electric pick up.

MODULE-2

UNIT-1 **8L+8T+0P=16 Hours**

PHOTOELECTRIC AND PIEZO ELECTRIC SENSORS:

Phototube, Scintillation counter, Photo multiplier tube (PMT), Photovoltaic, Photo conductive cells, Photo diodes, Phototransistor, Comparison of photoelectric transducers, Spectro photometric applications of photo electric transducers; Piezoelectric active transducer and biomedical applications as pressure and ultrasound transducers.

UNIT-2 **8L+8T+0P=16 Hours**

BIOSENSORS:

Introduction, Biological elements, Immobilization of biological components, Micro machined biosensor

SKILLS:

- ✓ *Determination of common instrument parameters.*
- ✓ *Finding the characteristics of transducers.*
- ✓ *Identify different transducers and sensors.*
- ✓ *Verification through different measuring systems.*
- ✓ *Measuring and calibrating a system*

- cantilever based chemical sensors, biosensors for diabetes mellitus, FAB. Biochip - introduction, lab on chip and gene chip, principles of optical biosensors, classification, immobilization techniques, optical biosensors for measurement of blood glucose level, smart sensor.

PRACTICES:

- Obstacle detection using ultrasonic sensor
- Design a biosensor for diabetes mellitus
- Design optical biosensors for blood glucose level
- Design a smart biosensor for physiological

COURSE OUTCOMES:

Upon successful completion of this course, students will have to ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the signal conditioning circuit relevant to the different types of sensor	Apply	1	1, 2, 4, 9, 10
2	Infer the principles and working of photoelectric sensors along with the biomedical applications.	Apply	1	1, 2, 9, 10
3	Distinguish the principles of different types of biosensors	Analyze	1	1, 2, 5, 9, 10
4	Design biosensors applications in the medical field.	Analyze	2	1, 2, 3, 6, 9, 10, 12
5	Evaluate the physical quantity and test its characteristics by using suitable sensors	Evaluate	2	1, 2, 4, 5, 9, 10

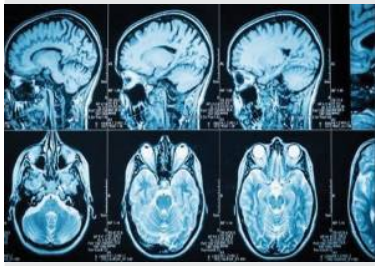
TEXT BOOKS:

1. A.K. Sawhney, “Electrical and Electronics Measurement and Instrumentation”,12th edition, Dhanpat Rai and Co, 2021.
2. Khandpur R.S, “Handbook of Biomedical Instrumentation”, 4th edition, Tata McGraw-Hill, 2014.

REFERENCE BOOKS :

1. Leslie Cromwell, “Biomedical Instrumentation and measurement”, 3rd edition, Prentice hall of India, 2015.
2. John G. Webster, “Medical Instrumentation Application and Design”, 5th edition, John Wiley and sons, 2020.
3. Albert D. Helfrick and William D. Cooper, “Modern Electronic Instrumentation and measurement techniques”, 3rd edition, Prentice Hall, 2016.

22BM402 MEDICAL IMAGE PROCESSING



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Hours Per Week :

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Medical Imaging Techniques, Biomedical Signal Processing.

COURSE DESCRIPTION AND OBJECTIVES:

This course imparts the working knowledge of medical image processing, various techniques of transformation, enhancement, restoration, compression, segmentation and image morphology. The course gives the knowledge of all kinds of image processing in biomedical applications.

MODULE–1

UNIT-1 **6L+6T+6P=18 Hours**

IMAGE FUNDAMENTALS:

Introduction, Steps in digital image processing, Components, Elements of visual perception, Image sampling and quantization, Relationships between pixels, Color models.

IMAGE ENHANCEMENT: 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.

UNIT-2 **10L+10T+10P=30 Hours**

IMAGE RESTORATION:

Noise models, Mean filters, Order statistics, Adaptive filters, Band reject filters, Band pass filters, Notch filters, Optimum notch filtering, Inverse filtering, Wiener filtering.

PRACTICES: USING MATLAB / PYTHON:

- Determine Image sampling and quantization
- Analysis of spatial and intensity resolution of images
- Determine Intensity transformation of images.
- Analysis of images with different color models
- Histogram processing.
- Image enhancement spatial filtering.
- Image enhancement filtering in frequency domain
- Image filtering -Adaptive filters, Band reject filters, Band pass filters, Notch filters, Optimum notch filtering, Inverse filtering, Wiener filtering.
- Analysis of images with different color models.

MODULE-2

UNIT-1 **8L+8T+8P=24 Hours**

THRESHOLDING AND SEGMENTATION:

Detection methods, Optimal thresholding, Multi-spectral thresholding; Edge based segmentation, Region based segmentation, Matching, Advanced optimal border and surface detection approaches, thresholding, applications – US, MRI, CT images.

IMAGE REPRESENTATION AND RECOGNITION:

Boundary representation - chain code, polygonal approximation, signature, boundary segments,

SKILLS:

- ✓ *Process medical images using different techniques.*
- ✓ *Diagnose abnormalities in a given health problem relative to imaging.*
- ✓ *Gain knowledge to write or device their own model for specifically pertaining problems*
- ✓ *Critically understand the mathematics behind image processing*

boundary description, shape number, Fourier descriptor, moments regional descriptors, topological feature; Texture - patterns and pattern classes, recognition based on matching.

UNIT-2 **8L+8T+8P=24 HOURS**

MATHEMATICAL MORPHOLOGY:

Basic morphological concepts, Morphological principles: Binary dilation and erosion, Gray scale dilation and erosion, skeletons and object marking, graundometry, Morphological segmentation and water sheds; Applications of image processing techniques to MRI Images, Dicom, CT and Functional MRI images.

PRACTICES:

- Image segmentation edge detection, line detection and point detection.
- Region based image segmentation
- Thresholding based image segmentation
- Basic morphological operations.
- Morphological segmentation and water sheds

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the various transforms to enhance images in frequency domain	Apply	1	1, 2, 4, 9, 10, 12
2	Apply image segmentation and restoration techniques to US,CT,MRI images	Apply	2	1, 2, 5, 9, 10, 12
3	Analyze the techniques for image representation.	Analyze	1	1, 2, 4, 5, 9, 10
4	Apply the techniques of mathematical morphology useful for image processing	Apply	2	1, 2, 5, 9, 10, 12
5	Develop program for processing a medical image by various algorithms for different applications	Creative	2	1, 2, 3, 5, 9, 10

TEXT BOOKS:

1. Rafael C, Gonzalez, Richard E. Woods, Steven Eddins, “Digital Image Processing using MATLAB”, Pearson Education, Inc., 3rd edition, 2020.
2. Jayaram, Kudupa and Gabor, T Herman, “3D imaging in medicine”, 2nd edition, CRC press, 2000.

REFERENCE BOOKS:

1. Milan Sonka, Vaclav Hlavac and Roger Boyle, “Image processing, analysis and machine vision, 4th edition, Brooks/Cole Publishing Co., 2014.
2. John C Russ, “The image processing handbook”,6th edition, CRC and IEEE press, 2011.
3. Milan Sonka, “Digital Image Processing and Computer Vision”, 3rd edition, India edition, 2013.

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DEPT.
ELECTIVES

BIOMEDICAL ENGINEERING

B.Tech.

22BM801	-	Medical Informatics
22BM802	-	Assist devices and Implant Technology
22BM803	-	Physiological Control Systems
22BM804	-	Biofluids and Dynamics
22BM805	-	Embedded system and IoT in health care
22BM806	-	Rehabilitation Engineering
22BM807	-	Fiber Optics and Lasers in Medicine
22BM808	-	Telemedicine
22BM809	-	Soft Computing Techniques
22BM810	-	Medical Physics
22BM811	-	Medical Equipment Maintenance and Troubleshooting
22BM812	-	Robotics and Automation in Medicine
22BM813	-	Machine Vision in Medical Technology
22BM814	-	Virtual Bio-Instrumentation
22BM815	-	Virtual Reality
22BM816	-	VLSI for Bioengineers

COURSE CONTENTS

I SEM & II SEM

22BM801 MEDICAL INFORMATICS

https:// bioscience.ucla.edu/home-areas/ medical-informatics/

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Data Structures.

COURSE DESCRIPTION AND OBJECTIVES:

This course provides a full introduction to the issues involved in the current practice of medical informatics. Major course topics address challenges related to the implementation of electronic health records and other medical and health care data bases in patient care settings, and their effective use in managing and improving personal and public health. The describe how the health care information infrastructure is used to collect, process, maintain, exchange, and disseminate data and demonstrate familiarity with information systems that employ communication and computer technology to collect, maintain, access, evaluate, and interpret health care / public health data.

MODULE–1

UNIT-1 **6L+6T+0P=12 Hours**

MEDICAL INFORMATICS:

Medical informatics, Bioinformatics, Health informatics, Structure of medical informatics, Functional capabilities of hospital information system, On-line services and off line services, Dialogue with the computer.

UNIT-2 **10L+10T+0P=20 Hours**

MEDICAL STANDARDS:

Evolution of medical standards, IEEE 11073, HL7, DICOM, IRMA, LOINC, HIPPA, Electronics patient records, Healthcare standard organizations, JCAHO, JCIA, Evidence based medicine, Bioethics.

PRACTICES:

- Apply basic knowledge to the research and practice of medical informatics
- Differentiate the Medical informatics, Bioinformatics, Health informatics
- Compare and contrast electronic medical record (EMR) with electronic health record (EHR).
- Analyze the professional governing rules and regulations for medical informatics
- Analysis emergence of Personal Health Records and their implications for patients, health care providers, and health systems
- Evaluate the medical standards and practices
- Evidence based medicine
- Bioethics

MODULE-2

UNIT-1 **8L+8T+0P=16 Hours**

MEDICAL DATA STORAGE AND AUTOMATION:

Representation of data, Data modeling techniques, Relational hierarchical and network approach, Normalization techniques for data handling, Plug-in data acquisition and Control boards, Data acquisition using serial interface, Medical data formats, Signal, Image and video formats, Medical databases, Automation in clinical laboratories, Intelligent laboratory information system, PACS.

SKILLS:

- ✓ *Develop data organizing techniques and tools.*
- ✓ *Organize and plan according to client requirement.*
- ✓ *Analyze different data storage techniques*

UNIT-2 **8L+8T+0P=16 Hours**

HEALTH INFORMATICS:

Bioinformatics databases, Bio-information technologies, Semantic web and Bioinformatics, Genome projects, Clinical informatics, Nursing informatics, Public health informatics, Education and training.

RECENT TRENDS IN MEDICAL INFORMATICS: Medical expert systems, Virtual reality applications in medicine, Virtual environment, Surgical simulation, Radiation therapy and planning, Telemedicine, Virtual hospitals, Smart medical homes, Personalized e-health services, Biometrics, GRID and Cloud computing in medicine.

PRACTICES:

- Apply normalization techniques for medical data handling
- Develop the medical data organization formats
- Apply the semantic web technology for organization clinical informatics
- Develop automated validation of test results
- Analyze the radiation therapy and planning
- Apply telemedicine technology using cloud computing.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply information and communication technology in healthcare	Apply	1	1, 2, 6, 9, 10, 12
2	Analyze the professional governing rules and regulations for medical informatics	Analyze	1	1, 2, 4, 5, 9, 10
3	Identify the various medical data formats and information systems.	Apply	1	1, 2, 4, 5, 9, 10, 12
4	Analyse the bioinformatics technologies, education and training.	Apply	2	1, 2, 9, 10, 12
5	Infer the recent trends in medical informatics using emerging technologies and Evaluate the decision making concepts used in healthcare and them applications.	Evaluate	2	1, 2, 4, 5, 6 9, 10, 12

TEXTBOOKS:

1. Pentti Nieminen, “Medical Informatics and data analysis” MDPI Publishing, 2021.
2. Nguyen Thi Dieu Linh, Zhongyu, “Data Science and Medical Informatics in Healthcare Technologies”, Springer, 2021.

REFERENCEBOOKS:

1. Arvind Kumar Bansal, Javed Iqbal Khan, S. Kaisar Alam, “Introduction to Computational Health Informatics”, CRC press, 2020.
2. Robert E. Hoyt, Ann K. Yoshihashi, “Health informatics –Practical guide for healthcare and information technology”,6th edition, AMIA,2014.
3. Pawan Singh Mehra, Lalit Mohan Goyal, Arvind Dagur, “Healthcare Systems and Health Informatics: Using Internet of Things” CRC Press,2022.

22BM802 ASSIST DEVICES AND IMPLANT TECHNOLOGY

https:// weca pable. com/ assistive-technology

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Aanlog and digital electronics, Biomaterials.

COURSE DESCRIPTION AND OBJECTIVES:

This course imparts knowledge of the various mechanical techniques that will help failing heart. The objectives of this course are to learn the functioning of the unit which does the clearance of urea from the blood and know the various orthotic devices and prosthetic devices to overcome orthopaedic problems.

MODULE –1

UNIT-1 **6L+0T+6P=12 Hours**

CARDIAC ASSIST DEVICES:

Principle of external counter pulsation techniques, Intra-aortic balloon pump, Auxiliary ventricle and schematic for temporary bypass of left ventricle, Prosthetic heart valves, Latest use of assistive technology for chronic heart diseases and health care Information technology, Future trends in assistive technology.

UNIT-2 **10L+0T+10P=20 Hours**

ASSISTIVE TECHNOLOGY FOR MOBILITY:

Basic assessment and evaluation for mobility, Control systems, Navigation in virtual space by wheel chairs, Wheel chair seating and pressure ulcers, Fuzzy logic expert system for automatic tuning of myoelectric prostheses, Intelligent prosthesis.

PRACTICES:

- Design and analysis the cardiac assist devices
- Design and analysis mobility aids like wheelchair, robotic legs etc
- Apply design tools for modeling and analysis of assist devices
- Combine instrumentation techniques for development of assist devices to human

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

HEARING AIDS:

Common tests - Audiograms, Air conduction, Bone conduction, Masking techniques, SISI; Hearing aids - Principles, Drawbacks in the conventional unit, DSP based hearing aids; Augmentative and alternative methods for hearing impairment, Use of multimedia technology to help hard of hearing children, Haptic as a substitute for vision.

UNIT-2 **8L+0T+8P=16 Hours**

PROSTHETIC AND ORTHODIC DEVICES:

Hand and arm replacement, Different types of models: Externally powered limb prosthesis, Myoelectric limb prosthesis, Feedback in orthodic system, Functional electrical stimulation, Sensory assist devices.

SKILLS:

- ✓ *Know the devices used for artificial functioning of organ system.*
- ✓ *Gain knowledge on filtration techniques involved in the kidneys.*
- ✓ *Determine the criticality involved in the hearing loss.*
- ✓ *Test process involved in the audiological process.*
- ✓ *Ascertain the need for implants for knee and selection of materials on them.*

PRACTICES:

- Design DSP based hearing aids
- Design the myoelectric limb prosthesis
- Analyse the feedback in orthodic system
- Design the sensory assist devices.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Determine the function of various hearing aids	Analyze	1	1, 2, 9, 10
2	Differentiate the limb prostatic device models based on its function	Analyze	1	1, 2, 4 9, 10
3	Apply the standard techniques used for cardiac and orthopedic assist devices	Apply	1	1, 2, 5, 9, 10
4	Analyze the design parameters of implants and prostatic devices	Apply	2	1, 2, 3, 5, 9, 10, 12
5	Design the prostatic and implants that solve clinical problems of societal people	Create	2	1, 2, 3, 6 9, 10

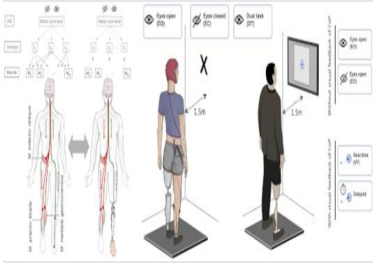
TEXT BOOKS:

1. Edwige Pissaloux, Ramiro Velazquez (ed), “Mobility of Visually Impaired People- Fundamentals and ICT Assistive Technologies”, Springer, 2018.
2. Samuel R. Atcherson, “Hearing Assistive and Access Technology”, Plural Publisher, 2014.

REFERENCES BOOKS:

1. Khandpur, R.S, “Telemedicine technology and applications (mHealth, Tele Health and eHealth)”. PHI Learning Pvt. Ltd., 2017.
2. Maria Cristina Annesini, Luigi Marrelli, Vincenzo Piemonte, Luca Turchetti, “Artificial Organ Engineering”, Springer, 2017.
3. Carl E. Misch, “Dental Implant Prosthetics - E-Book” Elsevier,2nd edition,2014.

22BM803 PHYSIOLOGICAL CONTROL SYSTEMS



https://www.imtek.de/professuren/bmt/forschung%20/physiological controlsystems?set_language=en

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Basics of circuit theory, differentiation and complex numbers.

COURSE DESCRIPTION AND OBJECTIVES:

The purpose of this course to study various control systems modelling techniques, time response analyses and frequency response analysis, biological control systems can be analysed and understood. It is aimed at study of system concept and different mathematical techniques applied in analysing any given system and also useful to analyse the given system in time domain and frequency domain. Its study includes the techniques of plotting the responses in domains, application and analysis of biological systems.

MODULE-1

UNIT-1 **6L+6T+0P=12 Hours**

INTRODUCTION TO CONTROL SYSTEMS:

Classification of control systems, Open loop and closed loop control systems with examples, Difference between engineering and physiological control systems, Examples of positive and negative feedback, Physiological control systems, Physiological open loop verses closed loop system; Block diagram reduction and signal flow graphs, Control system components - P, I, D controllers.

UNIT-2 **10L+10T+0P=20 Hours**

TIME RESPONSE ANALYSIS AND STABILITY:

Standard test signals, Time response of first order and second order systems, Design specifications of second order systems, Steady state response, Steady state errors.

STABILITY: Necessary conditions for stability, R-H stability criteria, Concept and construction of root locus.

PRACTICES:

- Develop simple mathematical models of physiological control systems
- Apply the basic analytical techniques in control theory to determine the dynamic characteristics of linear closed-loop systems
- Analyze and simulate the dynamics of simple nonlinear oscillators, neuronal models and closed-loop nonlinear systems with delayed feedback
- Use MATLAB and SIMULINK software to analyze and simulate models of physiological systems
- Stability analysis using Routh's Hurwitz criterion.
- Stability analysis using Root Locus Technique.
- MODULE-2

UNIT-1 **8L+8T+0P=16 Hours**

PHYSIOLOGICAL CONTROL SYSTEMS ANALYSIS:

Determination of steady - state operating point, Regulation of cardiac output, Regulation of glucose, Chemical regulation of ventilation, Dynamics of neuromuscular reflex motion.

SKILLS:

- ✓ *Determine overall transfer function of a system using block diagram reduction technique and SFG method.*
- ✓ *Equipping students with necessary knowledge on analysis and design parameters.*
- ✓ *Apply various mathematical techniques in designing of Bio-control systems.*
- ✓ *Stability analysis of any system in the time and frequency domain.*
- ✓ *Create simple models of biological systems.*
- ✓ *Characterize physical system based on bode plots.*

UNIT-2 **8L+8T+0P=16 Hours**

FREQUENCY RESPONSE ANALYSISAND STABILITY:

Correlation between time and frequency response, Bode plots; Stability - introduction, Nyquist stability criteria.

STABILITY ANALYSIS OF LINER APPROCHES: Stability analysis of pupillary light reflex, Model of Cheyne stokes breathing; Identification of closed loop system - opening the loop; Starling Heart -lung preparation, artificial brain perfusion for partitioning central and peripheral chemoreflexes, read rebreathing technique.

PRACTICES:

- Frequency analysis using Bode plots.
- Nyquist stability criteria

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Classify and model the physiological control system.	Apply	1	1, 2, 9, 10
2	Model a system by applying the concept of state space analysis	Analyze	1	1, 2, 5, 9, 10, 12
3	Model the physiological system along with the stability analysis	Analyze	1	1, 2, 5, 9, 10
4	Analyze the time response and stability of first and second order system.	Analyze	2	1, 2, 4, 9, 10, 12
5	Analyze the frequency domains of the given system using different mathematical techniques. Design and develop portable physiological control systems	Create	2	1, 2, 3, 4, 9, 10

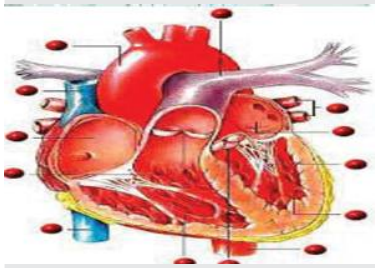
TEXT BOOKS:

1. Joseph Distefano (Author), Allen Stubberud “Control Systems”, 3rd edition, Mc Graw Hill education, 2017.
2. Ashfaq Husain, Harroon Ashfaq, “Control Systems”, 3rd edition, Dhanpat Co Publishers, 2016.

REFERENCE BOOKS:

1. Michael C. Khoo, “Physiological Control Systems-Analysis, Simulation and Estimation”,2nd edition, IEEE Press, 2018.
2. Benjamin C. Kuo, “Automatic Control Systems”, John Wiley India Pvt. Ltd., 9th edition, 2014.
3. Nagarath I.J. and Gopal M., “Control Systems Engineering”, 5th edition, New Age International (P) Limited, Publishers, 2017.

22BM804 BIOFLUIDS AND DYNAMICS



https://mech2 . sites.olt.ubc.ca / files/2014/01/ Mech-533-2013W.pdf

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Biomechanics.

COURSE DESCRIPTION AND OBJECTIVES:

This course introduces students to fundamental physical concepts and mathematical equations describing the dynamics of fluid flows and their application to bio fluid mechanical problems. Provide the students a solid background in the physical principles and mathematical foundations of fluid mechanics and its application in biomedical problems. This course will substantially strengthen the quantitative and analytical skills of bioengineering students.

MODULE - 1

UNIT-1: **6L+6T+0P=12 Hours**

BIO-FLUID MECHANICS:

Newton's laws, Stress, Strain, Elasticity, Hooks-law, Viscosity, Newtonian fluid, Non-newtonian fluid, Viscoelastic fluids, Vascular tree, Relationship between diameter, Velocity and pressure of blood flow, Resistance against flow; Bioviscoelastic fluid - viscoelasticity, viscoelastic models, maxwell, voigt and kelvin models, response to harmonic variation, use of viscoelastic models, Bio-Viscoelastic fluids, protoplasm, mucus, saliva, synovial fluids.

UNIT-2: **10L+10T+0P=20 Hours**

FLOW PROPERTIES OF BLOOD:

Physical, Chemical and rheological properties of blood; Apparent and relative viscosity, Blood viscosity variation, Effect of shear rate, Hematocrit, Temperature, Protein contents of blood; Casson's equation, Problems associated with extracorporeal blood flow; Rheology of blood in microvessels, Fahraeus - Lindquist effect and inverse effect, Distribution of suspended particles in a narrow rigid tube, Nature of red blood cells in tightly fitting tubes, Hematocrit in very narrow tube.

PRACTICES:

- Apply Newton's laws for examine the force and pressure of Biofluids analysis
- Apply Viscoelastic for investigate the elastic properties of fluids and blood viscosity variation
- Analyse physical, chemical and rheological properties of blood
- Analysis the Rheology of blood in microvessels
- Apply the Fahraeus - Lindquist effect and inverse effect
- Analysis distribution of suspended particles in a narrow rigid tube,
- Measure the Hematocrit in very narrow tube

MODULE-2

UNIT-1 **8L+8T+0P=16 Hours**

CARDIAC MECHANICS:

Cardiovascular system - mechanical properties of blood vessels, arteries, arterioles, capillaries and veins; Blood flow- laminar and turbulent; Physics of cardiovascular diseases, Prosthetic heart valves and replacements; Respiratory mechanics - alveoli mechanics, interaction of blood and lung P-V curve of lung; Breathing mechanism, Airway resistance, Physics nm of lung diseases.

SKILLS:

- ✓ *Modeling and design of Biofluid flow and characterization*
- ✓ *Methods of blood flow properties in vascular system*
- ✓ *Development of Prosthetic heart valves and Cardiovascular system*
- ✓ *Development of soft and hard tissue joints*

UNIT-2 **8L+8T+0P=16 Hours**

SOFT TISSUE MECHANICS:

Pseudo elasticity, Non-linear stress-strain relationship, Viscoelasticity structure, Function and mechanical properties of skin, Ligaments and tendons.

HARD MECHANICS: Mechanical properties of cartilage, Diffusion properties of articular cartilage, Mechanical properties of bone, Kinetics and kinematics of joints, Lubrication of joints.

PRACTICES:

- Analysis of mechanical properties of blood vessels, arteries, arterioles, capillaries and veins
- Design the modeling of Blood flow- laminar and turbulent
- Examine the blood and lung P-V curve of lung and Breathing mechanism
- Measure the mechanical properties of skin, Ligaments and tendons.
- Measure mechanical properties of cartilage bone
- Measure the Kinetics and kinematics of joints

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Determine the respiratory and cardiovascular systems	Analyze	1	1, 2, 10
2	Model the respiratory and cardiovascular systems	Analyze	1	1, 2, 3, 5, 9, 10, 12
3	Analyze the mechanical properties of skin ligaments and tendons.	Analyze	1	1, 2, 5, 6, 9, 10
4	Apply the chemical and rheological properties of blood.	Apply	2	1, 2,4, 9, 10
5	Evaluate the flow of blood and hematocrit in broad and narrow tubes.	Evaluate	2	1, 2, 4, 5, 9, 10

TEXT BOOKS:

1. Joseph Hamill, Knutzen, Kathleen M, Derrick, Timothy R, “Biomechanical Basis of Human Movement”,2nd edition, Springer Verlag, 2021.
2. David A. Rubenstein, Weiyin, Mary D. Frame, “Biofluid mechanics an introduction to fluid mechanics, Macro circulation and Microcirculation”, 1st edition, Springer, 2013.

REFERENCE BOOKS:

1. Ferdiansyah Mahyudin, Hendra Hermawan. Biomaterials and Medical Devices”, 1st edition, Springer, 2016.
2. Paulo Jorge Bártolo, Bopaya Bidanda, “Bio-Materials and Prototyping Applications in Medicine”,2nd edition,Edward Arnold ltd, 2021.
3. B. Ritter, Vikki Hazelwood, Antonio Valdevit, Alfred N. Ascione, “Biomedical Engineering Principles”, 2nd edition, CRC Press,2011.

22BM805 EMBEDDED SYSTEM AND IOT IN HEALTH CARE

https://www.axiomtek.com/Default.aspx?MenuId=Solutions&FunctionId=Solution View&ItemId =2138

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Analog and digital communication.

COURSE DESCRIPTION AND OBJECTIVES:

The purpose of learning this course on embedded systems in medical devices for biomedical engineering students is to impart knowledge in the design of embedded system for various medical devices with IoT.

MODULE–1

UNIT-1 **6L+0T+6P=12 Hours**

INTERNET CONCEPTS AND INFRASTRUCTURE:

Broad Band Transmission facilities –Open Interconnection standards –Local Area Networks – Wide Area Networks –Network management – Network Security – Cluster computers. Internet concepts - Capabilities and limitations of the internet -– Interfacing Internet server applications to corporate databases HTML and XML Web page design through programming and the use of active components.

UNIT-2 **10L+0T+10P=20 Hours**

DESIGN METHODOLOGY AND PROTOCOLS:

Introduction-Characteristics-Physical design - Protocols – Logical design – Enabling technologies – IoT Levels – Domain Specific IoTs – IoT vs M2M. IOT design methodology –IoT systems management – IoT Design Methodology – Specifications Integration and Application Development.

PRACTICES:

- IoT based logical design of medical instrument
- Design specific IoT based pulse oximeter
- Design Protocols for IoT based medical device
- Analyse IoT vs M2M

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

EMBEDDED SYSTEMS:

Generic Embedded Systems Structure- Components of Embedded Systems- Sensors and Actuators- importance of Analog/Digital Conversion- Embedded system based physiological monitoring system Health care innovations using embedded.

UNIT-2 **8L+0T+8P=16 Hours**

DIGITAL HEALTH:

Evolution of digital health-social Technological alignment – laws and regulations for digital health- ethical issues.

IoT IN HEALTH CARE: IOT based health care- physiological parameter monitoring system- future challenges in health care- health care echo system with IOT- IOT for personalized health care- wearable device characteristics-analysis of power aware protocols and standards for critical e-health applications, social network analysis in health care, embedded health care system for senior resident using IOT.

SKILLS:

- ✓ *Equipping students with necessary knowledge on analysis and design parameters.*
- ✓ *Application of various mathematical techniques in designing of embedded system*
- ✓ *Analyze a medical system using IoT*

PRACTICES:

- Design IoT based health care system
- Develop Embedded system based physiological monitoring system
- Design the IOT based personalized health care- wearable device
- Analysis of power aware protocols and standards for critical e- health applications

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the features of ATmega processor	Apply	1	1, 2, 9, 10
2	Design a biomedical application in an embedded processor.	Create	1	1, 2, 3, 5, 9, 10 ,12
3	Write embedded programming for real time applications	Create	1	1, 2, 5, 9, 10, 12
4	Design embedded system for patient monitoring systems	Create	2	1, 2, 3, 4,5 9, 10
5	Design and analyze the develop prototype using IOT	Evaluate	2	1, 2, 3, 4, 9, 10, 12

TEXT BOOKS:

1. Raj Kamal, " Embedded Systems" 4th edition, Mc Graw Hill,2020.
2. K.V.Shibu, "Introduction to Embedded Sytems" 2nd edition, Mc Graw Hill,2016.

REFERENCE BOOKS:

1. Samuel A. Fricker, Christoph Thuemmler, Anastasius Gavras Requirements Engineering Dor Digital Health springer 2015.
2. Klaus Pohl, Harald Hönninger, Reinhold Achatz, Manfred Broy, "Model-Based Engineering Of Embedded Systems: The SPES 2020 Methodology, Springer, 2012.
3. Rahul K. Kher, Chirag Paunwala, Falgun Thakkar, IoT Applications for Healthcare Systems, Springer 2022.
4. Eugene C. Nelson, Paul B. Batalden, Marjorie M. Godfrey, "Quality by Design: A Clinical Microsystems Approach,2nd edition, John wiley & sons 2021.

22BM806 REHABILITATION ENGINEERING

https://relab.ethz.ch/

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Assist devices and implant technology.

COURSE DESCRIPTION AND OBJECTIVES:

The course aims at how a patient has to undergo different recovery methods after injury,accidents or enabling differently abled people to restore their ability to better capability. Study the principles of rehabilitation. Know new rehabilitation concepts for future development and applications. Learn therapeutic exercise techniques. Understand orthopaedic prosthetics and orthotics in rehabilitation.

MODULE–1

UNIT-1 **6L+6T+0P=12 Hours**

REHABILITATION TEAM:

What is rehabilitation, Epidemiology of rehabilitation, Health, Levels of prevention, Preventive rehabilitation, Diagnosis of disability, Functional diagnosis, Importance of psychiatry in functional diagnosis, Impairment disability handicap, Primary and secondary disabilities, Rehabilitation team classification of members, The role of psychiatrist, Occupational therapist, Physical therapist, Recreation therapist, Rehabilitation nurse, Social worker, Corrective therapist, Music and Dance therapist & Biomedical engineer.

UNIT-2 **10L+10T+0P=20 Hours**

REHABILITATION THERAPEUTIC EXERCISE TECHNIQUE:

Human component, Principles of assistive technology assessment and rehabilitation engineering, Key engineering and ergonomic principles, Practice of rehabilitation and assistive technology; Therapeutic exercise technique - coordination exercises, balance training, gait, pathological gaits; Gait training - crutch walking, patterns of gait, relaxation exercises, methods for training relaxation, strengthening exercises.

PRACTICES:

- Apply engineering concepts in rehabilitation medicine
- Design and analysis mobility aids like wheelchair, robotic legs etc
- Design therapeutic exercise technique
- Analyze the gait lab and various pathological gaits

MODULE-2

UNIT-1 **8L+8T+0P=16 Hours**

ENGINEERING CONCEPTS IN SENSORY AUGMENTATION AND SUBSTITUTION:

Visual system- visual augmentation, tactual vision substitution and auditory vision substitution, auditory system, auditory augmentation, audiometer, hearing aids, cochlear implantation, visual auditory substitution, tactual auditory substitution, tactual system, tactual augmentation, tactual substitution.

UNIT-2 **8L+8T+0P=16 Hours**

ORTHOTIC & PROSTHETIC DEVICES:

General orthotics, Classification of orthotics - functional and regional, general principles of orthosis, calipers - FO, AFO, KAFO, HKAFO; Amputation – general principles of amputation surgery, levels of

SKILLS:

- ✓ *Know the rehabilitation engineering principles and concepts.*
- ✓ *Apply various techniques involved for bringing patient back to normal situations.*
- ✓ *Determine the criticality involved in loss of sense.*
- ✓ *Analyse movement of normal and abnormal gait.*
- ✓ *Gait analysis using gait analysis laboratory.*

amputation in upper limb and lower limb, rehabilitation of lower limb amputations; Prosthetic devices - hand and arm replacement, body powered prosthetics, myoelectric controlled prosthetics and externally powered limb prosthetics.

COMPUTER APPLICATIONS AND MOBILITY AID IN REHABILITATION ENGINEERING: Interfaces in compensation for visual perception, Improvement of orientation and mobility, Computer assisted lip reading, Brain computer interface; Mobility Aids - functions, parallel bars; Walking frames - types, walking stick, tripods, quadripods; Crutches - types; Wheel chairs - parts and maintenance.

PRACTICES:

- Design and analyse various tools to be used in sensory and motor rehabilitation
- Design and fabricate upper and lower limb orthoses and prostheses
- Provide technical solution to overcome the challenges faced during geriatric and pediatric rehabilitation
- Predict the design of mobility aids

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply engineering concepts in rehabilitation medicine	Apply	1	1, 2, 6, 9, 10
2	Apply various rehabilitation engineering aids based on advancements in technologies	Apply	1	1, 2, 4, 5, 6, 9, 10, 12
3	Design and analyse various tools to be used in sensory and motor rehabilitation	Analyze	2	1, 2, 3, 4, 5, 9, 10
4	Analyze the gait lab and various pathological gaits.	Analyze	2	1, 2,4, 9, 10, 12
5	Evaluate the orthotic and prosthetic devices of upper and lower limbs.	Evaluate	2	1, 2, 4, 6, 9, 10

TEXT BOOKS:

1. S.Sunder, “Rehabilitation Medicine”, 4th edition, Jaypee Medical Publications,2019.
2. Joseph D. Bronzino, “The Biomedical Engineering Handbook”, 4th edition, Three volume set, CRC Press, 2015.

REFERENCE BOOKS:

1. Rory A Cooper, “An Introduction to Rehabilitation Engineering”, 1st edition, Taylor & Francis, CRC press, 2012.
2. Susan B O’Sullivan, Thomas J Schmitz, “Physical Rehabilitation”, 6th edition, Davis publications, 2014.
3. Andrew Y.J. Szeto, “Assistive Technology and Rehabilitation Engineering” IGI Global publisher, 2014.

22BM807 FIBER OPTICS AND LASERS IN MEDICINE

https://www.
nepalitele com.com/
nepals-own-optical
-fiber-to-the-sea

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Applied Physics.

COURSE DESCRIPTION AND OBJECTIVES:

This course imparts the knowledge of different laser techniques used in medicine and also know the photonics instrumentation. The objective of this course is to be familiar with fiber optics property of tissues and be exposed to optical.

MODULE - I

UNIT-1 **6L+0T+6P=12 Hours**

LASERS IN THERAPY & DIAGNOSIS:

Laser assisted diagnosis and therapy, Interaction of laser beams and materials - principles laser interaction with tissue; Laser assisted diagnostics - principles, applications of lasers in diagnosis and imaging, advances; Laser surgery and therapy - principles photo, thermal and photo mechanical mechanisms; Thermal interaction between laser and tissue - advances.

UNIT-2 **10L+0T+10P=20 Hours**

SINGLE OPTICAL FIBERS:

Historical background, Optical fibers fundamentals, Light transmission in optical fibers principles, Optical properties of optical fibers advances, Fabrication of optical fibers principles, Optical fibers for UV, Visible, IR Light-principles, Power transmission through optical fibers principles, Modified fiber ends and tips principles, Fiber lasers advances.

PRACTICES:

- The basics and principles of LASERS in Medicine
- Determine interference patterns, principle of hologram.
- Determine the Power transmission through optical fibers
- Demonstrate the mechanism of optical fibers transmission

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

OPTICAL FIBER BUNDLES:

Non-ordered fiber-optic bundles for light guides fundamentals and principles; Ordered fiber optic bundles for imaging devices - fundamentals and principles, fiber scopes and endoscopes fundamentals; Fiber optic imaging systems - advances.

UNIT-2 **8L+0T+8P=16 Hours**

ENDOSCOPY:

Endoscopic imaging systems - fundamentals, principles, advances; Endoscopic diagnostics - advances, endoscopic therapy fundamentals; Endoscopic ultrasound imaging - principles.

CLINICAL APPLICATIONS OF FIBER OPTIC LASER SYSTEMS: Fiber optic laser systems in cardiovascular disease, Gastroenterology, Gynecology, Neurosurgery, Oncology, Ophthalmology,

SKILLS:

- ✓ *Principles of light Interactions in tissues*
- ✓ *Differentiate the lasers involved in the different departments and units.*
- ✓ *Know the special techniques for imaging in biological structures.*
- ✓ *Instrumentation and techniques involved in the photonics.*
- ✓ *Practice in-vitro clinical diagnostic, fluorescent spectroscopy, photodynamic therapy*

Orthopedics, Otolaryngology (ENT), Urology, Flow diagram for laser angioplasty and Photodynamic therapy.

PRACTICES:

- Analysis of the laser tissue welding
- Practice in-vitro clinical diagnostic, fluorescent spectroscopy, photodynamic therapy
- Recommendation of laser safety aspects
- Outline the clinical applications of fiber optic Lasers systems
- Standard practices of the use of laser in medicine and surgery
- Medical applications of endoscopy

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Categorize the properties and principles of light propagation in Optical fiber system	Analyze	1	1, 2,4, 9, 10, 12
2	Apply the endoscopic ultrasound imaging system.	Apply	1	1, 2, 6, 9, 10 ,12
3	Analyze the applications of Laser in Therapy and diagnosis	Analyze	1	1, 2, 4, 6, 9, 10, 12
4	Determine the clinical applications of fiber optic system such as cardiovascular disease, ENT and gastroenterology etc	Analyze	2	1, 2, 4, 5, 9, 10, 12
5	Evaluate the optical fiber bundles in medical endoscope applications.	Evaluate	2	1, 2, 4, 6, 9, 10

TEXT BOOKS:

1. Daniele Tosi, Guido Perrone, “Fiber-Optic Sensors for Biomedical Applications”, Adam Hilgar Brustol Inc, 2017.
2. Andrew Motes, “A Student’s Guide to Fiber Lasers”, 1st edition Gordon Breach, Science Publishers Inc., 2014.

REFERENCE BOOKS:

1. Zujie Fang, Ken Chin, Ronghui Qu, Haiwen Cai, “Fundamentals of Optical Fiber Sensors”, 1st Edition, WILEY, 2012.
2. Daniele Tosi, Guido Perrone, “Fiber-Optic Sensors for Biomedical Applications”, Adam Hilgar Brustol Inc, 2017.
3. Abraham Katzir, “Lasers and Optical Fibers in Medicine”, 1st edition, Elsevier,2012.

22BM808 TELEMEDICINE

https://www.science.org/content/article/telemedicine-takes-center-stage-era-covid-19

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Analog and digital communication.

COURSE DESCRIPTION AND OBJECTIVES:

This course describes the various communication networks, antennas in designing the telemedicine system. It also explains basic parts of tele radiology systems like image acquisition system, display system, communication network and interpretation. It is useful to know scope, benefits and limitations of telemedicine, security and standards and their use in tele medicine applications.

MODULE - 1

UNIT-1 **6L+6T+0P=12 Hours**

INTRODUCTION:

Block diagram of telemedicine system, Definition of tele medicine, Tele health, Tele care, Origins and development of tele medicine, Scope, Benefits and limitations of telemedicine.

UNIT-2 **10L+10T+0P=20 Hours**

DATA INFORMATION:

Audio, Video, Still images, Text and data, Fax. Types of communication and network; PSTN, POTS, ATN, ISDN, Internet, Wireless communications; GSM, Satellite and micro Wave; Different modulation techniques, Types of antennas depending on requirements, Integration and Operational issues, System integration, Store and forward operation, Real-time tele medicine.

PRACTICES:

- Security and Standards and their use in Telemedicine Applications
- Different modulation techniques
- Design the Telemedicine System
- Analysis modulation techniques for communication
- Determine the of antennas depending on requirements
- Apply the wireless communication technologies in telemedicine

MODULE-2

UNIT-1 **8L+8T+0P=16 Hours**

DATA EXCHANGES:

Network configuration, Circuit and packet switching H.320 series (Video phone based ISBN) T.120, H.324 (Video phone based PSTN), Video conferencing.

DATA SECURITY AND STANDARDS:

Encryption, Cryptography, Mechanisms of encryption, Phases of encryption; Protocols - TCP/IP, ISO-OSI, Standards to followed DICOM, HL7; Ethical and legal aspects of telemedicine, Confidentiality and law, Patient lights and consent, Access to medical records, Consent treatment, Jurisdictional issues, Intellectual property rights.

SKILLS:

- ✓ *Know the scope of telemedicine in health care.*
- ✓ *Understand the techniques for reduction of different treatments over communication lines.*
- ✓ *Increase the services without creating physical infrastructure.*
- ✓ *Gain knowledge on quickly following up patients discharged after palliative care.*
- ✓ *Radio diagnostic or therapeutic standard maintaince and trade off study of quality over telemedicine*
- ✓ *Patient information and health level7/level8 regulations.*

UNIT-2 **8L+8T+0P=16 Hours**

TELE RADIOLOGY:

Basic parts of tele radiology system, Image acquisition system, Display system, Communication network, Interpretation, Tele pathology - multimedia databases, Color images of sufficient resolution, Dynamic range, Spatial resolution, Compression methods, Interactive control of color, Controlled sampling, Security and confidentiality tools, Tele cardiology, Tele oncology, Tele surgery.

PRACTICES:

- Analyze various communication protocols for telemedicine
- Apply the telemedicine systems in teleradiology, tele oncology, tele
- Patient information and health level7/level8 regulations
- Ethical and legal aspects of telemedicine
- Mechanisms of encryption, Phases of encryption
- Access to medical records

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the information types used in the telemedicine system	Apply	1	1, 2, 4, 9, 10, 12
2	Analysis the clinical applications of telemedicine systems such as teleradiology, tele oncology, tele surgery etc	Analyze	1	1, 2, 4, 5, 9, 10, 12
3	Apply the wireless communication technologies in telemedicine	Apply	1	1, 2, 9, 10, 12
4	Analyze the standards and ethical, security aspects of telemedicine.	Analyze	2	1, 2, 6, 8, 9, 10, 12
5	Evaluate the concept of data communication, networks, and video conferencing	Evaluate	2	1, 2, 4, 9, 10

TEXT BOOKS:

1. Halit Eren, John G. Webster, “Telemedicine and Electronic Medicine”, CRC press, 2015.
2. Shashi Bhushan Gogia, “Fundamentals of Telemedicine and Telehealth”, Academic Press, 2019.

REFERENCE BOOKS:

1. Khandpur, R.S, “Telemedicine technology and applications (mHealth,TeleHealth and eHealth)”. PHI Learning Pvt. Ltd., 2017.
2. Tanupriya Choudhury, Avita Katal, Jung-Sup Um, Ajay Rana, Marwan Al-Akaidi, “Telemedicine: The Computer Transformation of Healthcare”. Springer, 2022.
3. Bernard Fong, A.C.M.Fong, C. K. Li, “Telemedicine Technologies: Information Technologies in Medicine and Digital Health”. 2nd edition, WILEY, 2020.

22BM809 SOFT COMPUTING TECHNIQUES

https://autome.me / artificial-intelligence the-definition-types-applications -and-companies/

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Medical Image Processing.

COURSE DESCRIPTION AND OBJECTIVES:

This course provides an introduction to the basic concepts of Soft Computing methodology and covers three main components – Neural Networks, Fuzzy Logic and Evolutionary Computation. The course combines theoretical foundations with practical applications using different tools and techniques. the objectives of the course are to learn the various soft computing frame works, be familiar with design of various neural networks, be exposed to fuzzy logic, learn genetic programming, be exposed to hybrid systems.

MODULE - 1

UNIT-1 **6L+0T+6P=12 Hours**

INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORKS:

Overview of Soft Computing, Soft Vs Hard computing, brief descriptions of different components of soft computing, Introduction to Biological neural network, Artificial neural networks Vs Biological neural networks, ANN architecture and classification. Introduction to Early ANN Architectures-McCulloch & Pitts model, Perceptron, ADALINE, MADALINE.

UNIT-2 **10L+0T+10P=20 Hours**

SUPERVISED AND UNSUPERVISED LEARNING:

Supervised Learning: Introduction and how brain works, Neuron as a simple computing element, the perceptron, Back-propagation networks: model for multilayer perceptron, back-propagation learning, accelerated learning in multilayer perceptron.

Unsupervised Learning: Hebbian Learning, Generalized Hebbian learning algorithm, Competitive learning, Self- Organizing Computational Maps: Kohonen Network.

PRACTICES: MATLAB SIMULATION

- Artificial Neural Network (ANN) implementation
- NN Tool Artificial Neural Network (ANN) implementation
- Training Algorithms of ANN.
- Supervised Learning and Unsupervised Learning
- Back-propagation networks and learning

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

FUZZY SET THEORY:

CRISP SETS: operations, properties, partition and covering, Fuzzy sets: Membership function, operation and properties, Fuzzy relations and Crisp relations.

FUZZY SYSTEMS: Crisp Logic, Predicate Logic, Fuzzification, Membership value assignment, Fuzzy Logic, Fuzzy rule-based systems, Defuzzification, Fuzzy applications.

SKILLS:

- ✓ *Customize a suitable model for uncertainty problems.*
- ✓ *Customize a model for the particular problem.*
- ✓ *Identify the Fuzzy relations and Crisp relations.*
- ✓ *Design of various neural networks Architectures*
- ✓ *Implement fuzzy, NN and GA to various problems*
- ✓ *Create schematics to digital system using CMOS.*
- ✓ *Evaluate the performance of the given system for available soft computing tools.*
- ✓ *Simulate a given image using NN.*

UNIT-2 **8L+0T+8P=16 Hours**

GENETIC ALGORITHM:

Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation, Generational Cycle, applications.

PRACTICES:

- Apply fuzzy logic and reasoning to handle uncertainty and solve various problems
- Apply Fuzzy relations and Crisp relations
- Apply neural networks to pattern classification and regression problems
- Apply genetic algorithms to combinatorial optimization problems
- Evaluate and compare solutions by various soft computing approaches for a given problem.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the different soft computing techniques to medical images	Apply	1	1, 2, 9, 10
2	Apply neural network architectures and learning algorithms, for different problems.	Analyze	1	1, 2, 4, 9, 10, 12
3	Apply rough set theory to solve process control applications	Apply	1	1, 2, 4 9, 10, 12
4	Apply the concept of fuzzy systems to real applications.	Apply	2	1, 2, 4, 9, 10, 12
5	Analyze the genetic algorithms and their applications	Analyze	2	1, 2, 4, 9, 10

TEXT BOOKS:

1. S.N. Sivanandam and S.N. Deepa, “Principles of Soft Computing”, Wiley India Pvt. Ltd, 1st edition, 2011.
2. J.S.R.Jang, C.T. Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, Pearson Education, 2015.

REFERENCE BOOKS:

1. Margarita-Arimatea Díaz-Cortés, Erik Cuevas, Raúl Rojas, “Engineering Applications of Soft Computing” Pearson Education India, 2017.
2. Snehashish Chakraverty, Deepti Moyi Sahoo, Nisha Rani Mahato, “Concepts of Soft Computing-Fuzzy and ANN with Programming” Springer, 2019.
3. Rashid Ali, MM Sufyan Beg, “Applications of Soft Computing for the Web”, Springer, 2017.
4. D. K. Pratihar, “Soft Computing: Fundamentals and Applications”, Alpha Science, 2014.

22BM810 MEDICAL PHYSICS

https://sos.dkut.ac.ke/mathe matics-and-physical-sciences/bachelor- of-science-in-medical- physics/

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Medical imaging modalities.

COURSE DESCRIPTION AND OBJECTIVES:

This course gives the knowledge to the students on how the radiation interacts with tissue and organs, principles of ionization radiation and non-ionization radiation. This course gives the student ready for working in the safe environment in controlled areas and in restricted areas.

MODULE - 1

UNIT-1 **6L+6T+0P=12 Hours**

NON IONIZING RADIATION AND ITS MEDICAL APPLICATION:

Non-ionizing, Electromagnetic radiation, Overview of non-ionizing radiation, Effects - low frequency effects, higher frequency effects; Physics of light, Measurement of light and its unit, Limits of vision and color vision an overview, Thermography– application.

UNIT-2 **10L+10T+0P=20 Hours**

PRINCIPLES OF RADIOACTIVE NUCLIDES:

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, Decay series, Production of radionuclides, Cyclotron produced radionuclide, Reactor produced radionuclide fission and electron capture reaction, Radionuclide generator, Technetium generator.

PRACTICES:

- Application of the radiation concepts and methods of physics in medical
- Accentuate the principle, effects and clinical applications of ionizing, non-ionizing and electromagnetic radiation.
- Explore the effects of radiation in matter and how isotopes are produced
- Explore the application of Radionuclide used in medicine
- Examine the production of radionuclides, cyclotron
- Radionuclide and Technetium generation

MODULE-2

UNIT-1 **8L+8T+0P=16 Hours**

INTERACTION OF RADIATION WITH MATTER:

Interaction of charged particles with matter, Specific gamma radiation with matter, Photoelectric effect, Compton scattering, Pair production, Attenuation of gamma radiation, Interaction of neutron with matter and their clinical significance.

UNIT-2 **8L+8T+0P=16 Hours**

BASIC RADIATION QUANTITIES:

Introduction, Exposure - inverse square law, KERMA - Kerma and absorbed dose, stopping power;

SKILLS:

- ✓ *Show the good and safe practices for radiation effected areas.*
- ✓ *Understand the physics involved behind diagnostic and therapeutic methods.*
- ✓ *Analyze Production of radioisotopes*
- ✓ *Know the interactions that are involved for image formations for various Modalities*
- ✓ *Detect tumor using thermography.*

Relationship between the dosimetry quantities, Bremsstrahlung radiation, Bragg's curve, Concept of LD 50, Stochastic and non-stochastic effects, Different radiation unit - Roentgen, Gray, Sievert.

PRACTICES:

- Calculate radiation dosimetry quantities
- Calculate radiotherapy, linacs, dose deposition
- Inverse square law and KERMA calculation
- Explore the effects of Stochastic and non-stochastic

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Classify different radiation decays	Analyze	1	1, 2
2	Compare different subatomic particles' interaction with matter.	Analyze	1	1, 2, 9, 10
3	Apply the principles of electromagnetic radiation to categorize ionization and non-ionization radiation.	Apply	1	1, 2, 5, 9, 10, 12
4	Apply the concepts of ultrasound to analyses its image formations and biological effects	Apply	2	1, 2, 7, 8, 9, 10, 12
5	Estimate the radiation doses.	Apply	2	1, 2, 3, 5, 9, 10

TEXT BOOKS:

1. John R Cameran, James G Skofronick, "Physics of the Human Body", 2nd edition, John-Wiley and Sons, 2016.
2. W.J. Meredith and J.B. Massey, "Fundamental Physics of Radiology", 3rd edition, Varghese Publishing House, 2013.

REFERENCE BOOKS:

1. C.S. Sureka, C. Armpilia, "Radiation Biology for Medical Physicists", CRC Press LC, 2017.
2. Anna Bajek,Bartosz Tylkowski, "Medical Physics: Models and Technologies in Cancer Research", Taylor and Francis, 2021.
3. Peter R. Hoskins, "Diagnostic Ultrasound Physics and Equipment", 2nd edition, Cambridge University Press, 2010.

22BM811 MEDICAL EQUIPMENT MAINTENANCE AND TROUBLESHOOTING

https://media.careersinthemilitary.com / citm-images/0094.00.jpg

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Biomedical Instrumentation.

COURSE DESCRIPTION AND OBJECTIVES:

Understand troubleshooting of electrical and electronic equipment and Learn the troubleshooting of medical equipment. Apply the tools in design, testing and developing medical equipment.

MODULE - 1

UNIT-1 **8L+0T+8P=16 Hours**

TESTING OF ELECTRICAL EQUIPMENTS:

AC, DC power supply, Grounding, shielding, Guarding, insulation testing, insulation resistance measurement, Types of Circuit Breakers, Rating – Testing of circuit breakers –Transformer testing-Earthing –Earth wires -Earthing of appliances –contactor, relay testing–CT and PT, Panel wiring-Megger-Testing equipment and instruments.

TESTING OF ELECTRONIC COMPONENTS: Troubleshooting of PCB boards, Calibration of analog and digital sensor probe, display interface, DC Power supply design, testing, Safe electrical practice, Cables and standard, Fuse.

UNIT-2 **8L+0T+8P=16 Hours**

TESTING OF SURGICAL EQUIPMENT:

Functions and operating Procedure-Testing and maintenance of Heart lung machine, surgical lights, ventilator, patient monitor, anesthesia machine, dialyzer, surgical tools.

PRACTICES:

- Identify the reasons for equipment failure.
- Interpret the need for grounding aspects, maintenance and troubleshooting.
- Develop the test bench, tools and methods for troubleshooting.

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

TROUBLESHOOTING OF EQUIPMENTS:

X-ray machines, Troubleshooting of ECG recorders, incubator, baby warmer, infusion pumps, annual maintenance, contract requirements, vendor services, quality and safety standards.

LIFE CYCLE MANAGEMENT OF MEDICAL EQUIPMENT: Cost of the medical equipment, maintenance cost, replacement analysis, managing equipment service, decision making, extracting optimal benefit from medical equipment over its life cycle, case study.

UNIT-2 **8L+0T+8P=16 Hours**

RELIABILITY IN MEDICAL DEVICES:

Need for reliability, Tools for reliability assurance, MTBF, MTTR, FMEA, Fault tree analysis, Markov

SKILLS:

- ✓ *Design and Implement device troubleshooting process*
- ✓ *Examine the devices condition and evaluate for recommend troubleshooting*
- ✓ *Recommend the suitable troubleshooting technique*
- ✓ *Use the hardware and software tools for troubleshooting.*

method, cause failure analysis. Human errors in healthcare systems, human factors approach to reduce error, Quality assurance through regulatory compliance: ISO: 9000, FDA, IEEE, ASTM, UL, CE, Computerized Maintenance management system for medical equipment.

PRACTICES:

- Classify the performance to various systems and maintained
- Design simple design troubleshooting methods for surgical devices
- Apply standards and regulations for maintain reliability in medical devices

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Interpret the need for grounding aspects, maintenance and troubleshooting.	Apply	1	1, 2, 9, 10, 12
2	Construct the test bench, tools and methods for troubleshooting	Creative	1	1, 2, 9, 10, 12
3	Develop troubleshooting system and formulate planning for the solutions for various devices	Analyze	1	1, 2, 3, 5, 9, 10, 12
4	Analyze various types of problem and solution for troubleshooting formation	Analyze	2	1, 2, 4, 9, 10, 12
5	Formulate advanced methods to solve critical problems.	Creative	2	1, 2, 3, 4, 5, 9, 10, 12

TEXT BOOKS:

1. Joseph. J Carr, John M Brown, Introduction to Biomedical Equipment Technology, John Wiley& Sons, New York,4th edition, 2014.
2. Keith Willson, Keith Ison, Slavik Tabakov, “Medical equipment management”, CRC Press, UK, 2014.

REFERENCE BOOKS:

1. Jenny Dooley, John Lehnert Virginia Evans, “Career Paths: Medical Equipment Repair”, Express Publishing, UK, 2018.
2. Shakti Chatterjee, Aubert Miller, “Biomedical Instrumentation systems”, Cengage Learning Technology & Engineering, 2014.
3. David Herres, “Troubleshooting and Repairing Commercial Electrical Equipment”, McGraw Hill Professional edition, 2013.
4. R. S. Khandpur, “Troubleshooting Electronic Equipment” 2nd Edition, McGraw Hill, 2014.

22BM812 ROBOTICS AND AUTOMATION IN MEDICINE

https://www.ul.com / news/safety-testing-healthcare-robotics

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Biomedical Instrumentation.

COURSE DESCRIPTION AND OBJECTIVES:

To provide the basic knowledge on design, analysis, control and working principle of robotics in surgery, rehabilitation and drug delivery (Nano robot).

MODULE - 1

UNIT-1 **6L+0T+6P=12 Hours**

INTRODUCTION OF ROBOTICS:

Introduction to robotics and its history, Overview of robot sub systems, Degrees of freedom, Configurations and concept of workspace, Automation, Mechanisms and Movements, Dynamic stabilization - applications of robotics in medicine.

UNIT-2 **10L+0T+10P=20 Hours**

ACTUATORS AND GRIPPERS:

Pneumatic and hydraulic actuators, Stepper motor control circuits, End effectors, Various types of grippers, Design consideration in vacuum and other methods of gripping, PD and PID feedback actuator models

MANUPULATORS & BASIC KINEMATICS:

Construction of manipulators, Manipulator dynamic and force control, Electronic and pneumatic manipulator, Forward kinematic problems, Inverse kinematic problems, Solutions of inverse kinematic problems.

PRACTICES:

- Demonstration different types of medical robots and their potential applications
- Summarize the principles of sensors, actuators and grippers for robots
- Use the software tools for designing and analyzing the robot motion
- Create stepper motor control circuits
- Design consideration in vacuum and other methods of gripping
- Construction of manipulators and force control system
- Summarize kinematics, dynamics, and control relevant to medical robotics

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

POWER SOURCES AND SENSORS:

Sensors and controllers, Internal and external sensors, Position, Velocity and acceleration sensors, Proximity sensors, Force sensors, Laser range finder, Variable speed arrangements, Path determination, Machinery vision, Ranging - laser acoustic, magnetic fiber optic and tactile sensor.

UNIT-2 **8L+0T+8P=16 Hours**

ROBOTICS IN MEDICINE:

SKILLS:

- ✓ *Design and Implement Robotics*
- ✓ *Create a compelling proposal for a new medical robot technology*
- ✓ *Examine concepts in kinematics, dynamics, and control relevant to medical robotics*
- ✓ *Recommend the suitable principles for specific conditions*
- ✓ *Use the software tools for designing and analyzing the robot motion.*

Da vinci surgical system, Image robotic systems for focal ultrasound based surgical applications, System concept for robotic, Tele surgical system for off pump CABG surgery, Urologic applications, Cardiac surgery, Neuro surgery, Pediatric and general surgery, Gynecologic surgery, General surgery and Nano robotics.

PRACTICES:

- Classify the performance to various sensors to its environment
- Design simple robots for surgical applications
- Apply state of the art in medical robotics and its applications

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply concepts of robotic systems with configuration and mechanism in the medical field	Apply	1	1, 2, 9, 10, 12
2	Apply the various concepts of manipulators, actuators and grippers for robot's system	Apply	1	1, 2, 9, 10, 12
3	Design basic robotics system and formulate Kinematic, Inverse Kinematic motion planning solutions for various Robotic configurations	Create	1	1, 2, 3, 5, 9, 10, 12
4	Analyze various types of sensors and power sources useful in robotic system design	Analyze	2	1, 2, 4, 9, 10, 12
5	Design and develop a Robotic system for Medical application.	Create	2	1, 2, 3, 4, 5, 9, 10, 12

TEXT BOOKS:

1. Andrew J. Kurdila, Pinhas Ben-Tzvi, "Dynamics and Control of Robotic Systems", John Wiley and Sons, 1st edition, 2019.
2. Saeed B. Niku, "Introduction to Robotics: Analysis, Control, Applications",3rd edition, WILEY, 2020.

REFERENCE BOOKS:

1. Jacob Rosen, Blake Hannaford & Richard M Satava, "Surgical Robotics: System Applications & Visions", Springer 2011.
2. Nagrath and Mittal, "Robotics and Control", Tata McGraw-Hill, 1st edition, 2017.
3. Constantinos Mavroidis, Antoine Ferreira, "Nanorobotics: Current approaches and Techniques", Springer 2013.

22BM813 MACHINE VISION IN MEDICAL TECHNOLOGY

https://dashtechinc.com/beyond-the-hype-artificial-intelligence-ai-in-medical-devices/

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Medical Image processing.

COURSE DESCRIPTION AND OBJECTIVES:

The goal is to create useful and significant value-added applications, especially using digital image processing and analysis. For example, research is focused on machine vision systems for process industry, and medical image analysis for the efficient healthcare of eye diseases.

MODULE - 1

UNIT-1 **6L+0T+6P=12 Hours**

MACHINE LEARNING FOR MACHINE VISION:

Learning and inference in vision, Geometric primitives and transformations, Photometric image formation, Digital camera usage, Global optimization, geometric intrinsic calibration, Regression model, Graphical model.

UNIT-2 **10L+0T+10P=20 Hours**

VISUALIZING OF OBJECTS IN MOTION:

Two frame structure from motion, Factorization, Constrained structure and motion, Dense motion estimation - parametric motion, motion models, image stitching.

PRACTICES:

- Features that can be used for a particular machine learning approach
- Classify contrast pros and cons of various machine learning techniques
- Infer various machine learning approaches and paradigms

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

3D RECONSTRUCTION - BASICS AND METHODS:

2D and 3D feature based alignment, Shape from X, Active range finding, Point based representations, Surface representations, Volumetric representations, Model based reconstruction, Recovering texture maps and albedos, Rendering -layered depth images, light fields and lumigraphs - 3D.

UNIT-2 **8L+0T+8P=16 Hours**

PHOTOGRAMMETRY AND STEREO METHODS:

Photometric calibration, High dynamic range imaging, Super resolution and blur removal, Image matting and compositing, Texture analysis and synthesis, Epipolar geometry, Sparse correspondence, Dense correspondence, Multiview stereo.

APPLYING COMPUTATIONAL VISION: Automated visual inspection, Computer vision in interventional cardiology, Fusion of three dimensional quantitative coronary angiography and intracoronary imaging for coronary interventions, Feature centric lesion detection and retrieval in thoracic images.

SKILLS:

- ✓ *Find features of biological structures.*
- ✓ *Identify objects that are stationery and in motion*
- ✓ *Analyse recent advances in machine learning algorithms.*
- ✓ *Explore learning paradigms towards applications.*
- ✓ *Explore to medical conditions to machine vision*

PRACTICES:

- Analyse the 2D and 3D reconstruction algorithms for representation of the objects
- Analyze the texture and synthesis, sparse and dense correspondence using stereo methods
- Analyze the use of photogrammetry and stereo methods for High dynamic range imaging.
- Evaluate the medical conditions in cardiology, using computer vision techniques

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the knowledge of motion estimation techniques to visualize the objects in motion	Apply	1	1, 2, 9, 10, 12
2	Analyse the 2D and 3D reconstruction algorithms for representation of the objects	Analyze	1	1, 2, 5, 9, 10, 12
3	Analyze the texture and synthesis, sparse and dense correspondence using stereo methods	Analyze	1	1, 2, 3, 5, 9, 10, 12
4	Analyze the use of photogrammetry and stereo methods for High dynamic range imaging	Analyze	2	1, 2, 9, 10, 12
5	Evaluate the medical conditions in cardiology, using computer vision techniques	Evaluate	2	1, 2, 9, 10

TEXT BOOKS:

1. E.R. Davies, “Computer Vision Principles, Algorithms, Applications, Learning”, Elsevier, 5th edition, 2017.
2. Chi Hau Chen, “Computer Vision in Medical Imaging Series in Computer Vision”, World Scientific Publishing Co Ltd, 2014.

REFERENCE BOOKS:

1. Herwig Unger, Phayung Meesad, Sirapat, “Recent Advances in Information and Communication Technology”, 1st edition, Springer, 2015.
2. Xuegong Zhang, “Image and Graphics”, 8th International Conference, Springer, ICIG 2015.
3. Richard S. Zeliski , “Computer Vision: Algorithms and Applications”, Springer, 1st edition, 2022.
4. Simon J.D. Prince, “Computer vision: models, learning and inference”, 1st edition, Cambridge University Press, 2012.

22BM814 VIRTUAL BIO INSTRUMENTATION

https://www. youtube. com /watch?v= AC3mjv5wcQs

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Biomedical Instrumentation, Biosensors and Transducers, Engineering Physics.

COURSE DESCRIPTION AND OBJECTIVES:

This course convers the use of general purpose instrumentation for biomedical applications, the design aspects of virtual instruments from general purpose instruments which are highly in demand. It also covers the establishment of link between virtual instruments that are crucial for development process in biomedical engineering.

MODULE - 1

UNIT-1 **6L+0T+6P=12 Hours**

INTRODUCTION TO LABVIEW:

Introduction, Advantages of LabVIEW, Software environment, Creating and saving a VI, Front panel toolbar, Block diagram toolbar, Palettes, Shortcut menus, Property dialog boxes, Front panel controls and indicators, Block diagram, Data types, Data flow program, LabVIEW documentation resources, Keyword shortcuts.

UNIT-2 **10L+0T+10P=20 Hours**

GRAPHICAL SYSTEM DESIGN (GSD):

Introduction, GSD model, Design flow with GSD, Virtual instrumentation, Traditional instrumentation, Hardware and software invirtual instrumentation, Virtual instrumentation for test, Control and design, GSD using LabVIEW, Graphical programming and textural programming.

PRACTICES:

- Demonstration graphical system design approach and basic features and techniques of LabVIEW
- GSD model, Design flow with GSD
- Use the Hardware and software invirtual instrumentation
- Construction Virtual instrumentation for test

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

MODULAR PROGRAMMING:

Introduction, Modular programming in LabVIEW, Build a VI front panel and block diagram, ICON and connector pane, Creating an icon, Building a connector pane, Displaying sub VIs and express Vis as icons or expandable nodes, Creating subVIs from sections of aI, Opening and editing subVIs, Placing subVIs on block diagrams, Saving subVIs, Creating a standalone application.

DATA ACQUISITION:

DAQ software architecture, DAQ assistant, Channels and task configurations, Selecting and configuring a data acquisition device, Components of computer based measurement system.

SKILLS:

- ✓ *Design the virtual instruments using LabVIEW*
- ✓ *Development of virtual instruments using LabVIEW*
- ✓ *DAQ software utilization and acquisition of data*
- ✓ *Controlling devices automatic using VI*

UNIT-2 **8L+0T+8P=16 HOURS**

APPLICATION OF VI IN BIOMEDICAL ENGINEERING:

Design of virtual applications for Electrocardiography (ECG), Electromyography (EMG), Air Flow and Lung Volume, Heart Rate variability analysis, Noninvasive Blood Pressure Measurement, Biofeedback, Virtual Reality and 3D graphical modeling, Virtual Prototyping.

PRACTICES:

- Modular programming in LabVIEW
- Design the DAQ systems using LabVIEW
- Develop the LabVIEW and Biobench based medical device development applications
- Design the basic concepts of DAQ systems using LabVIEW, and Biobench software for EMG, ECG, analysis
- Designing and implementing rigorous Virtual bio instruments for medical applications
- Introduction, Exposure - inverse square law, KERMA - Kerma and absorbed dose, stopping power;

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the graphical system design approach and basic features and techniques of LabVIEW	Apply	1	1, 2, 9, 10, 12
2	Apply modular programming concepts for creation of VIs and employ DAQ assistant for configuration of hardware devices.	Apply	1	1, 2, 4, 9, 10, 12
3	Design the basic concepts of DAQ systems using LabVIEW, and Biobench software for EMG, ECG, analysis.	Analyze	1	1, 2, 3, 5, 9, 10, 12
4	Design the DAQ systems using LabVIEW, and Biobench software cardiopulmonary system analysis	Analyze	2	1, 2, 3, 4, 5, 9, 10 ,12
5	Develop the LabVIEW and Biobench based medical device development applications for surgical video systems and IV pumps for lifelong learning	Create	2	1, 2, 3, 4, 9, 10, 12

TEXT BOOKS:

1. Sanjay Gupta, “Virtual Instrumentation using LabVIEW”, 2nd edition, PHI Learning Private Limited, 2017.
2. Gray W Johnson, Richard Jennings “LabView Graphical Programming”, 4th edition, McGraw Hill Education, 2017.

REFERENCE BOOKS:

1. B. Srinivas, “Virtual Instrumentation Lab Manual”, Prentice Hall Publication, 2022.
2. D. Sengeni, “Sensors and Instrumentation Engineering Volume I”, Notion Press; 1st edition, 2022.
3. Jovitha Jerome, “Virtual Instrumentation using LabVIEW”, PHI Learning Private Limited, 2010.

22BM815 VIRTUAL REALITY

https://appen.com / blog/augmented-and-virtual-reality/

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Biosensors and Transducers, Engineering Physics.

COURSE DESCRIPTION AND OBJECTIVES:

This course explores the potential of a virtual world for delivering application, determine possible instructional designs, understand the limitations, understand the barriers, solutions, and costs associated and including required training.

MODULE - 1

UNIT-1 **6L+6T+0P=12 Hours**

INTRODUCTION:

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 and haptic feedback.

UNIT-2 **10L+10T+0P=20 Hours**

MODELING:

Geometric modeling, Kinematics modeling, Physical modeling, Behaviour modeling, Model management.

PRACTICES:

- Demonstration virtual reality-commercial VR technology
- Summarize the principles of Trackers, Navigation, and Gesture Interfaces
- Use the software tools for Modeling Geometric, Kinematics and Physical
- Design consideration in VR technology
- Construction of manipulators and force control system
- Summarize output Devices- Graphics displays, sound displays and haptic feedback.

MODULE-2

UNIT-1 **8L+8T+0P=16 Hours**

HUMAN FACTORS:

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-2 **8L+8T+0P=16 Hours**

VR PROGRAMMING:

Introducing Java 3D, Loading and manipulating external models using a lathe to make shapes; 3DSprites, Animated 3D sprites-particle systems.

APPLICATIONS: Medical applications, Military applications, Robotics applications, Advanced Real Time Tracking, Other applications, Games, Movies, Simulations, Therapy.

SKILLS:

- ✓ *Understand the concepts of components of virtual reality.*
- ✓ *Analyze the geo-metric modelling for systems*
- ✓ *Human factors involved in the acquisition systems*
- ✓ *Application of virtual reality for robotics*
- ✓ *Calculation of side effects of virtual reality*

PRACTICES:

- Design of VR technology relates to human perception and cognition
- Design and implement rigorous empirical experiments using VR
- Experience with using virtual environment technology in medical applications
- Designing and implementing rigorous empirical experiments using VR for medical applications

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Mod-ule No.	Mapping with POs
1	Apply the state- of- art design and utilize VR technical resources to the conduct of scientific research	Apply	1	1, 2, 3, 9, 10, 12
2	Design of VR technology relates to human perception and cognition	Analyze	1	1, 2, 3, 4, 5, 9, 10, 12
3	Create virtual environment technology, including 3D rendering software, tracking hardware, and input/output functions for capturing user data.	Create	1	1, 2, 3, 5, 9, 10, 12
4	Apply the software tools to make shapes; 3D sprites, animated 3D sprites-particle systems	Apply	2	1, 2, 5, 9, 10, 12
5	Designing and implementing rigorous empirical experiments using VR for medical applications	Create	2	1, 2, 3, 6, 9, 10, 12

TEXT BOOKS:

1. Matjaž Mihelj, Domen Novak, Samo Beguš, “Virtual Reality Technology and Applications”, 2nd edition, Springer,2014.
2. William R.Sherman, Alan Craig, “Understanding Virtual Reality, interface, Application and Design”, Elsevier, Morgan Kaufmann, 2018.

REFERENCE BOOKS:

1. Bill Fleming,”3D Modeling and surfacing”, Elsevier, Morgan Kauffman, 2021.
2. David H.Eberly, “3D Game Engine Design Practical Approach to Real-Time Computer Graphics”, Elsevier, 2017.
3. John Vince, “Virtual Reality Systems”, Pearson Education, 2017.
4. Andrew Davison, “Killer Game Programming in Java”, 2nd edition, Oreilly SPD, 2015

22BM816 VLSI FOR BIOENGINEERS

https://www.gousa.study/ms-in -vlsi-in-usa

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Analog and digital electronics.

COURSE DESCRIPTION AND OBJECTIVES:

The aim of this course is to introduce the basic concepts of digital circuit design using hardware description language and IC fabrication process with CMOS technology and basic electrical properties of MOS transistor. The objective is to introduce CMOS logic gates and their schematics and layouts for designing digital and/or analog circuits.

MODULE - 1

UNIT-1 **6L+0T+6P=12 Hours**

MOS TRANSISTOR INTRODUCTION:

Transistor operation, IDS-VDS relationship, Transistor parameters- Threshold voltage, Trans-conductance, Output conductance, Figure of merit; Pass transistor, NMOS inverter, Various pull ups, CMOS Inverter, Introduction of Bi-CMOS inverter.

UNIT-2 **10L+0T+10P=20 Hours**

MOS FABRICATION:

Introduction to IC technology - MOS, PMOS, NMOS and CMOS fabrication processes; Oxidation, Lithography, Diffusion, Ion implantation, Metallization, Encapsulation.

PRACTICES:

- Identify the CMOS layout levels, and the design layers used in the process sequence
- Design general steps required for processing of CMOS integrated circuits
- Design static CMOS combinational and sequential logic at the transistor level

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

MOS CIRCUIT DESIGN:

VLSI design flow, MOS layers, Stick diagrams and layout, Design rules for NMOS, CMOS and BICMOS circuits, Delay unit, Inverter delays, Driving capacitive loads, Propagation delays, Wiring capacitances.

UNIT-2 **8L+0T+8P=16 Hours**

SUBSYSTEM DESIGN:

Alternate gate circuits, Arithmetic circuits - Adders, Multipliers, Parity generators, Comparators, Zero and one detectors; Design capture tools, Design for testability, Simulation, Synthesis, Introduction to FPGA.

PRACTICES:

- Demonstrate different logic styles such as complementary CMOS logic
- Design the pass-transistor Logic, dynamic logic, etc
- Interpret the need for testability and testing methods in VLSI.

SKILLS:

- ✓ *Estimate the layout area and power dissipation of the circuit.*
- ✓ *Customize a model for the particular logic system.*
- ✓ *Identify the design flow of front end and back end.*
- ✓ *Identify the different colour codes for the layouts.*
- ✓ *Evaluate the performance of the given system for available CMOS technologies.*
- ✓ *Synthesize digital system and implement on FPGA kit.*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyse the operation of MOS transistor and understand the Electrical behaviour of MOS transistors.	Analyze	1	1, 2, 9, 10
2	Evaluate the fabrication process of different MOS technologies.	Evaluate	1	1, 2, 4, 5, 9, 10, 12
3	Design VLSI circuits and Layouts of simple MOS circuit using Lambda based design rules.	Create	1	1, 2, 3, 5, 9, 10, 12
4	Develop subsystems (digital circuits) using various logic methods and their limitations.	Create	2	1, 2, 3, 5, 9, 10, 12
5	Synthesize the digital circuits with hardware description language/schematic levels.	Create	2	1, 2, 3, 9, 10, 12

TEXT BOOKS:

1. Ajit Pal, “Low-Power VLSI Circuits and Systems”, Springer 2015.
2. Tomasz Wojcicki, “VLSI Circuits for Emerging Applications”, 1st edition, CRC Press, 2015.

REFERENCE BOOKS:

1. Shojiro Asai, “VLSI Design and Test for Systems Dependability” Springer, 2019.
2. N. Weste and K. Eshraghian, “Principles of CMOS VLSI Design”, Pearson Education, 2nd edition, 2012.
3. John F. Wakerly, “Digital Design Principles and Practices”, 3rd edition, Prentice Hall,2012.

HONORS

BIOMEDICAL ENGINEERING

B.Tech.

22BM951	-	Assist Devices and Implant Technology
22BM952	-	Embedded Systems for Medical Devices
22BM953	-	Biofluids and Dynamics
22BM954	-	Medical Physics
22BM955	-	Machine Vision in Medical Technology
22BM956	-	Soft Computing Techniques
22BM957	-	Robotics and Automation in Medicine
22BM958	-	Virtual Reality

COURSE CONTENTS

I SEM & II SEM

22BM951 ASSIST DEVICES AND IMPLANT TECHNOLOGY

Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Aanlog and digital electronics, Biomaterials.

COURSE DESCRIPTION AND OBJECTIVES:

This course imparts knowledge of the various mechanical techniques that will help failing heart. The objectives of this course are to learn the functioning of the unit which does the clearance of urea from the blood and know the various orthotic devices and prosthetic devices to overcome orthopaedic problems.

MODULE–1

UNIT-1 **9L+0T+6P=15 Hours**

CARDIAC ASSIST DEVICES:

Principle of external counter pulsation techniques, Intra-aortic balloon pump, Auxiliary ventricle and schematic for temporary bypass of left ventricle, Prosthetic heart valves, Latest use of assistive technology for chronic heart diseases and health care Information technology, Future trends in assistive technology.

UNIT-2 **15L+0T+10P=25 Hours**

ASSISTIVE TECHNOLOGY FOR MOBILITY:

Basic assessment and evaluation for mobility, Control systems, Navigation in virtual space by wheel chairs, Wheel chair seating and pressure ulcers, Fuzzy logic expert system for automatic tuning of myoelectric prostheses, Intelligent prosthesis.

PRACTICES:

- Design and analysis the cardiac assist devices
- Design and analysis mobility aids like wheelchair, robotic legs etc
- Apply design tools for modeling and analysis of assist devices
- Combine instrumentation techniques for development of assist devices to human

MODULE-2

UNIT-1 **12L+0T+8P=20 Hours**

HEARING AIDS:

Common tests - Audiograms, Air conduction, Bone conduction, Masking techniques, SISI; Hearing aids - Principles, Drawbacks in the conventional unit, DSP based hearing aids; Augmentative and alternative methods for hearing impairment, Use of multimedia technology to help hard of hearing children, Haptic as a substitute for vision.

UNIT-2 **12L+0T+8P=20 Hours**

PROSTHETIC AND ORTHODIC DEVICES:

Hand and arm replacement, Different types of models: Externally powered limb prosthesis, Myoelectric limb prosthesis, Feedback in orthodic system, Functional electrical stimulation, Sensory assist devices.

https://wecapable.com /assistive-technology-meaning-examples/

SKILLS:

- ✓ *Know the devices used for artificial functioning of organ system.*
- ✓ *Determine the criticality involved in the hearing loss.*
- ✓ *Analyze the principle of external counter pulsation techniques.*
- ✓ *Analyze implantation of prosthetic heart valves.*

PRACTICES:

- Design DSP based hearing aids
- Design the myoelectric limb prosthesis
- Analyse the feedback in orthodic system
- Design the sensory assist devices.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Determine the function of various hearing aids	Analyze	1	1, 2, 9, 10
2	Differentiate the limb prostatic device models based on its function	Analyze	1	1, 2, 4 9, 10
3	Apply the standard techniques used for cardiac and orthopedic assist devices	Apply	1	1, 2, 4, 5, 9, 10
4	Analyze the design parameters of implants and prostatic devices	Analyze	2	1, 2, 3, 5, 9, 10, 12
5	Design the prostatic and implants that solve clinical problems of societal people	Create	2	1, 2, 3, 5 9, 10, 12

TEXTBOOKS:

1. Edwige Pissaloux, Ramiro Velazquez (ed), “Mobility of Visually Impaired People- Fundamentals and ICT Assistive Technologies”, Springer, 2018.
2. Samuel R. Atcherson, “Hearing Assistive and Access Technology”, Plural Publisher, 2014.

REFERENCEBOOKS:

1. Khandpur, R.S, “Telemedicine technology and applications (mHealth, Tele Health and eHealth)”. PHI Learning Pvt. Ltd., 2017.
2. Maria Cristina Annesini, Luigi Marrelli, Vincenzo Piemonte, Luca Turchetti, “Artificial Organ Engineering”, Springer, 2017.
3. Carl E. Misch, “Dental Implant Prosthetics - E-Book” Elsevier,2nd edition,2014.

22BM952 EMBEDDED SYSTEMS FOR MEDICAL DEVICES

Hours Per Week :

L	T	P	C
3	2	0	4

https:// dashtechinc. com /beyond-the-hype-artificial-intelligence-ai-in-medical-devices/

PREREQUISITE KNOWLEDGE: Analog and Digital Electronics.

COURSE DESCRIPTION AND OBJECTIVES:

The purpose of learning this course on embedded systems in medical devices for biomedical engineering students is to impart knowledge in the design of embedded system for various medical devices.

MODULE–1

UNIT-1 **6L+0T+6P=12 Hours**

EMBEDDED DESIGN WITH MICROCONTROLLERS: Product specification - hardware / software partitioning, Detailed hardware and software design, integration, product testing, microprocessor Vs micro controller, performance tools, bench marking processors.

UNIT-2 **10L+0T+10P=20 Hours**

PARTITIONING DECISION: Hardware / software duality, Hardware / software portioning, Coding for hardware / software development, ASIC revolution, Managing the risk, Co-verification, Execution environment memory organization of controller, Memory enhancement firmware, Speed and code density, System startup.

PRACTICES:

- Develop a Product specification - hardware / software partitioning system.
- Testing and evaluation of product with performance tools and benchmark the process.
- Analyzing the hardware / software portioning and coding

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

FUNCTIONALITIES FOR SYSTEM DESIGN: Timers, Watch dog timers, RAM, Flash memory, Basic toolset, Integration of hardware and firmware, Application programming, IDE, Target configuration, Host based debugging analyser, Remote debugging, ROM emulators, Logic.

UNIT-2 **8L+0T+8P=16 Hours**

DESIGN OF PATIENT MONITORING DEVICES: Design consideration of patient monitoring systems, Basic block diagram of pulse oximeter, Design requirement of device circuit implementation of interfacing of oximeter sensors with microcontoller, Software coding and implementation.

DESIGNING OF PACEMAKER: System description of pacemaker, Design requirement and basic block diagram of pacemaker, Interfacing of pacemaker elements with processors, Software coding of pacemaker and implementation.

PRACTICES:

- Design of a patient monitoring system
- Design of a pulse oximeter of device circuit and its interfacing
- Design of a pacemaker with interfacing elements and its processors

SKILLS:

- ✓ *Know the devices used for artificial functioning of organ system.*
- ✓ *Determine the criticality involved in the hearing loss.*
- ✓ *Analyze the principle of external counter pulsation techniques.*
- ✓ *Analyze implantation of prosthetic heart valves.*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the Hardware and Software partitioning for designing a product through microcontroller and microprocessor	Apply	1	1, 2, 4,5, 9,10, 12
2	Apply the hardware and software duality and partitioning for designing an embedded systems using microcontrollers	Apply	1	1, 2, 5, 9,10, 12
3	Analyze the functionalities of embedded system with debugging.	Analyze	1	1, 2, 5, 9,10,12
4	Design and develop pulse oximeter sensor with micro controllers.	Analyze	2	1, 2, 3,4, 9,10, 12
5	Design an embedded system for patient monitoring systems. Design and analyse the pacemaker with microprocessors.	Evaluate	2	1, 2,4,5, 9,10

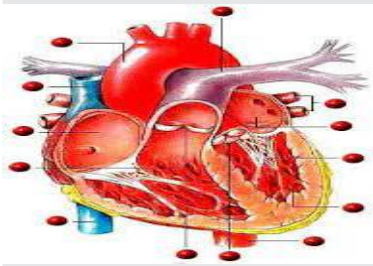
TEXTBOOKS:

1. James K. Peckol, “Embedded system Design”, John Wiley & Sons, 1st edition, 2010.
2. Jimenez M, Palomera R, Couvertier I, “Introduction to Embedded Stem”, 1st edition, Springer, 2014.

REFERENCEBOOKS:

1. Elicia White, “Making Embedded Systems”, O’Reilly Series, SPD, 1st edition, 2011.
2. G. Baura, “A Biosystems Approach to Industrial Patient Monitoring and Diagnostic Devices”, Morgan& Claypool, IEEE, 2008.
3. Kim R.Fowler, Craig L.Silver, “Developing and managing Embedded systems and Products “, 2nd edition, 2015.

22BM953 BIOFLUIDS AND DYNAMICS



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Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Biomechanics.

COURSE DESCRIPTION AND OBJECTIVES:

This course introduces students to fundamental physical concepts and mathematical equations describing the dynamics of fluid flows and their application to bio fluid mechanical problems. Provide the students a solid background in the physical principles and mathematical foundations of fluid mechanics and its application in biomedical problems. This course will substantially strengthen the quantitative and analytical skills of bioengineering students.

MODULE –1

UNIT-1 **9L+6T+0P=15 Hours**

BIO-FLUID MECHANICS:

Newton's laws, Stress, Strain, Elasticity, Hooks-law, Viscosity, Newtonian fluid, Non-newtonian fluid, Viscoelastic fluids, Vascular tree, Relationship between diameter, Velocity and pressure of blood flow, Resistance against flow; Bioviscoelastic fluid - viscoelasticity, viscoelastic models, maxwell, voigt and kelvin models, response to harmonic variation, use of viscoelastic models, Bio-Viscoelastic fluids, protoplasm, mucus, saliva, synovial fluids.

UNIT-2 **15L+10T+0P=25 Hours**

FLOW PROPERTIES OF BLOOD:

Physical, Chemical and rheological properties of blood; Apparent and relative viscosity, Blood viscosity variation, Effect of shear rate, Hematocrit, Temperature, Protein contents of blood; Casson's equation, Problems associated with extracorporeal blood flow; Rheology of blood in microvessels, Fahraeus - Lindquist effect and inverse effect, Distribution of suspended particles in a narrow rigid tube, Nature of red blood cells in tightly fitting tubes, Hematocrit in very narrow tube.

PRACTICES:

- Apply Newton's laws for examine the force and pressure of Biofluids analysis.
- Apply Viscoelastic for investigate the elastic properties of fluids and blood viscosity variation.
- Analyse physical, chemical and rheological properties of blood.
- Analysis the Rheology of blood in microvessels.
- Apply the Fahraeus - Lindquist effect and inverse effect.
- Analysis distribution of suspended particles in a narrow rigid tube.
- Measure the Hematocrit in very narrow tube.

MODULE-2

UNIT-1 **12L+8T+0P=20 Hours**

CARDIAC MECHANICS:

Cardiovascular system - mechanical properties of blood vessels, arteries, arterioles, capillaries and veins; Blood flow- laminar and turbulent; Physics of cardiovascular diseases, Prosthetic heart valves and replacements; Respiratory mechanics - alveoli mechanics, interaction of blood and lung P-V curve of lung; Breathing mechanism, Airway resistance, Physics nm of lung diseases.

SKILLS:

- ✓ *Equipping students with necessary knowledge on analysis and design parameters.*
- ✓ *Gain knowledge about application of various mathematical techniques in designing*
- ✓ *of biocontrol systems.*
- ✓ *Analyze a biological system*

UNIT-2 **12L+8T+0P=20 Hours**

SOFT TISSUE MECHANICS:

Pseudo elasticity, Non-linear stress-strain relationship, Viscoelasticity Structure, Function and mechanical properties of skin, Ligaments and tendons.

HARD MECHANICS: Mechanical properties of cartilage, Diffusion properties of articular cartilage, Mechanical properties of bone, Kinetics and kinematics of joints, Lubrication of joints.

PRACTICES:

- Analysis of mechanical properties of blood vessels, arteries, arterioles, capillaries and veins
- Design the modeling of Blood flow- laminar and turbulent
- Examine the blood and lung P-V curve of lung and Breathing mechanism
- Measure the mechanical properties of skin, Ligaments and tendons.
- Measure mechanical properties of cartilage bone
- Measure the Kinetics and kinematics of joints

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Determine the respiratory and cardiovascular systems	Analyze	1	1, 2, 9, 10
2	Model the respiratory and cardiovascular systems	Analyze	1	1, 2, 3, 5, 6, 9, 10
3	Analyze the mechanical properties of skin ligaments and tendons.	Analyze	1	1, 2, 4, 5, 9, 10
4	Interpret the chemical and rheological properties of blood.	Analyze	2	1, 2, 5, 9, 10, 12
5	Analyze the flow of blood and hematocrit in broad and narrow tubes.	Analyze	2	1, 2, 4, 6, 9, 10

TEXT BOOKS:

1. Joseph Hamill, Knutzen, Kathleen M, Derrick, Timothy R, “Biomechanical Basis of Human Movement”,2nd edition, Springer Verlag, 2021.
2. David A. Rubenstein, Weiyin, Mary D. Frame, “Biofluid mechanics an introduction to fluid mechanics, Macro circulation and Microcirculation”, 1st edition, Springer, 2013.

REFERENCES BOOKS:

1. Ferdiansyah Mahyudin, Hendra Hermawan. Biomaterials and Medical Devices”, 1st edition, Springer, 2016.
2. Paulo Jorge Bártolo, Bopaya Bidanda, “Bio-Materials and Prototyping Applications in Medicine”,2nd edition,Edward Arnold ltd, 2021.
3. B. Ritter, Vikki Hazelwood, Antonio Valdevit, Alfred N. Ascione, “Biomedical Engineering Principles”, 2nd edition, CRC Press,2011.

22BM954 MEDICAL PHYSICS

https://sos.dkut.ac.ke/mathematics-and-physical-sciences/bachelor -of-science-in- medical-physics/

Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Medical imaging modalities.

COURSE DESCRIPTION AND OBJECTIVES:

This course gives the knowledge to the students on how the radiation interacts with tissue and organs, principles of ionization radiation and non-ionization radiation. This course gives the student ready for working in the safe environment in controlled areas and in restricted areas.

MODULE–1

UNIT-1 **9L+6T+0P=15 Hours**

NON IONIZING RADIATION AND ITS MEDICAL APPLICATION:

Non-ionizing, Electromagnetic radiation, Overview of non-ionizing radiation, Effects - low frequency effects, higher frequency effects; Physics of light, Measurement of light and its unit, Limits of vision and color vision an overview, Thermography– application.

UNIT-2 **15L+10T+0P=25 Hours**

PRINCIPLES OF RADIOACTIVE NUCLIDES:

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, Decay series, Production of radionuclides, Cyclotron produced radionuclide, Reactor produced radionuclide fission and electron capture reaction, Radionuclide generator, Technetium generator.

PRACTICES:

- Application of the radiation concepts and methods of physics in medical
- Accentuate the principle, effects and clinical applications of ionizing, non-ionizing and electromagnetic radiation.
- Explore the effects of radiation in matter and how isotopes are produced
- Explore the application of Radionuclide used in medicine
- Examine the production of radionuclides, cyclotron
- Radionuclide and Technetium generation

MODULE-2

UNIT-1 **12L+8T+0P=20 Hours**

INTERACTION OF RADIATION WITH MATTER:

Interaction of charged particles with matter, Specific gamma radiation with matter, Photoelectric effect, Compton scattering, Pair production, Attenuation of gamma radiation, Interaction of neutron with matter and their clinical significance.

UNIT-2 **12L+8T+0P=20 Hours**

BASIC RADIATION QUANTITIES:

Introduction, Exposure - inverse square law, KERMA - Kerma and absorbed dose, stopping power; Relationship between the dosimetry quantities, Bremsstrahlung radiation, Bragg's curve, Concept of LD 50, Stochastic and non-stochastic effects, Different radiation unit - Roentgen, Gray, Sievert.

SKILLS:

- ✓ *Show the good and safe practices for radiation effected areas.*
- ✓ *Understand the physics involved behind diagnostic and therapeutic methods.*
- ✓ *Analyze Production of radioisotopes*
- ✓ *Know the interactions that are involved for image formations for various Modalities*

PRACTICES:

- Calculate radiation dosimetry quantities
- Calculate radiotherapy, linacs, dose deposition
- Inverse square law and KERMA calculation
- Explore the effects of Stochastic and non-stochastic

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Classify different radiation decays	Apply	1	1, 2, 9, 10
2	Compare different subatomic particles' interaction with matter.	Analyze	1	1, 2, 4, 5, 9,10
3	Apply the principles of electromagnetic radiation to categorize ionization and non-ionization radiation.	Apply	1	1, 2, 5, 9, 10, 12
4	Apply the concepts of ultra sound to analyses its image formations and biological effects	Apply	2	1, 2, 4, 5, 9, 10, 12
5	Estimate the radiation doses.	Evaluate	2	1, 2, 4, 9, 10

TEXT BOOKS:

1. John R Cameran, James G Skofronick, "Physics of the Human Body", 2nd edition, John-Wiley and Sons, 2016.
2. W.J. Meredith and J.B. Massey, "Fundamental Physics of Radiology", 3rd edition, Varghese Publishing House, 2013.

REFERENCE BOOKS:

1. C.S. Sureka, C. Armpilia, "Radiation Biology for Medical Physicists", CRC Press LC, 2017.
2. Anna Bajek,Bartosz Tylkowski, "Medical Physics: Models and Technologies in Cancer Research", Taylor and Francis, 2021.
3. Peter R. Hoskins, "Diagnostic Ultrasound Physics and Equipment", 2nd edition, Cambridge University Press, 2014.

22BM955 MACHINE VISION IN MEDICAL TECHNOLOGY

https:// dashtechinc. com /beyond-the-hype-artificial-intelligence-ai-in-medical-devices/

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Medical Image processing.

COURSE DESCRIPTION AND OBJECTIVES:

The goal is to create useful and significant value-added applications, especially using digital image processing and analysis. For example, research is focused on machine vision systems for process industry, and medical image analysis for the efficient healthcare of eye diseases.

MODULE-1

UNIT-1 **9L+0T+6P=15 Hours**

MACHINE LEARNING FOR MACHINE VISION:

Learning and inference in vision, Geometric primitives and transformations, Photometric image formation, Digital camera usage, Global optimization, geometric intrinsic calibration, Regression model, Graphical model.

UNIT-2 **15L+0T+10P=25 Hours**

VISUALIZING OF OBJECTS IN MOTION:

Two frame structure from motion, Factorization, Constrained structure and motion, Dense motion estimation - parametric motion, motion models, image stitching.

PRACTICES:

- Features that can be used for a particular machine learning approach
- Classify contrast pros and cons of various machine learning techniques
- Infer various machine learning approaches and paradigms

MODULE-2

UNIT-1 **12L+0T+8P=20 Hours**

3D RECONSTRUCTION - BASICS AND METHODS:

2D and 3D feature based alignment, Shape from X, Active range finding, Point based representations, Surface representations, Volumetric representations, Model based reconstruction, Recovering texture maps and albedos, Rendering -layered depth images, light fields and lumigraphs - 3D.

UNIT-2 **12L+0T+8P=20 Hours**

PHOTOGRAMMETRY AND STEREO METHODS:

Photometric calibration, High dynamic range imaging, Super resolution and blur removal, Image matting and compositing, Texture analysis and synthesis, Epipolar geometry, Sparse correspondence, Dense correspondence, Multiview stereo.

APPLYING COMPUTATIONAL VISION: Automated visual inspection, Computer vision in interventional cardiology, Fusion of three dimensional quantitative coronary angiography and intracoronary imaging for coronary interventions, Feature centric lesion detection and retrieval in thoracic images.

SKILLS:

- ✓ *Find features of biological structures.*
- ✓ *Identify objects that are stationery and in motion*
- ✓ *Analyse recent advances in machine learning algorithms.*
- ✓ *Explore learning paradigms towards applications.*
- ✓ *Explore to medical conditions to machine vision*

PRACTICES:

- Analyse the 2D and 3D reconstruction algorithms for representation of the objects
- Analyze the texture and synthesis, sparse and dense correspondence using stereo methods
- Analyze the use of photogrammetry and stereo methods for High dynamic range imaging.
- Evaluate the medical conditions in cardiology, using computer vision techniques

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the knowledge of motion estimation techniques to visualize the objects in motion	Apply	1	1, 2, 5, 9, 10
2	Analyse the 2D and 3D reconstruction algorithms for representation of the objects	Analyze	1	1, 2, 5, 9, 10, 12
3	Analyze the texture and synthesis, sparse and dense correspondence using stereo methods	Analyze	1	1, 2, 4, 5, 9, 10, 12
4	Analyze the use of photogrammetry and stereo methods for high dynamic range imaging	Analyze	2	1, 2, 4, 9, 10, 12
5	Evaluate the medical conditions in cardiology, using computer vision techniques	Evaluate	2	1, 2, 4, 5, 9, 10

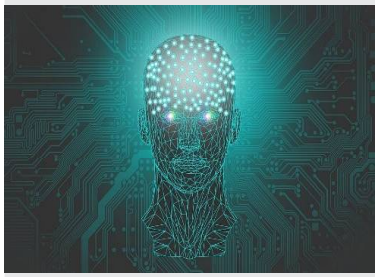
TEXT BOOKS:

1. E.R. Davies, “Computer Vision Principles, Algorithms, Applications, Learning”, Elsevier, 5th edition, 2017.
2. Chi Hau Chen, “Computer Vision in Medical Imaging Series in Computer Vision”, World Scientific Publishing Co Ltd, 2014.

REFERENCE BOOKS:

1. Herwig Unger, Phayung Meesad, Sirapat, “Recent Advances in Information and Communication Technology”, 1st edition, Springer, 2015.
2. Xuegong Zhang, “Image and Graphics”, 8th International Conference, Springer, ICIG 2015.
3. Richard S. Zeliski , “Computer Vision: Algorithms and Applications”, Springer, 1st edition, 2022.
4. Simon J.D. Prince, “Computer vision: models, learning and inference”, 1st edition, Cambridge University Press, 2012.

22BM956 SOFT COMPUTING TECHNIQUES



https://automeme /artificial-intelligence- the-definition-types-applications -and-companies

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Medical Image Processing.

COURSE DESCRIPTION AND OBJECTIVES:

This course provides an introduction to the basic concepts of Soft Computing methodology and covers three main components – Neural Networks, Fuzzy Logic and Evolutionary Computation. The course combines theoretical foundations with practical applications using different tools and techniques. the objectives of the course are to learn the various soft computing frame works, be familiar with design of various neural networks, be exposed to fuzzy logic, learn genetic programming, be exposed to hybrid systems.

MODULE - 1

UUNIT-1 **9L+0T+6P=15 Hours**

INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORKS:

Overview of Soft Computing, Soft Vs Hard computing, brief descriptions of different components of soft computing, Introduction to Biological neural network, Artificial neural networks Vs Biological neural networks, ANN architecture and classification. Introduction to Early ANN Architectures-McCulloch & Pitts model, Perceptron, ADALINE, MADALINE.

UNIT-2 **15L+0T+10P=25 Hours**

SUPERVISED AND UNSUPERVISED LEARNING:

Supervised Learning: Introduction and how brain works, Neuron as a simple computing element, the perceptron, Back-propagation networks: model for multilayer perceptron, back-propagation learning, accelerated learning in multilayer perceptron.

Unsupervised Learning: Hebbian Learning, Generalized Hebbian learning algorithm, Competitive learning, Self- Organizing Computational Maps: Kohonen Network.

PRACTICES:

- MATLAB simulation
- Artificial Neural Network (ANN) implementation
- NN Tool Artificial Neural Network (ANN) implementation
- Training Algorithms of ANN.
- Supervised Learning and Unsupervised Learning
- Back-propagation networks and learning

MODULE-2

UNIT-1 **12L+0T+8P=20 Hours**

FUZZY SET THEORY:

Crisp sets: operations, properties, partition and covering, Fuzzy sets: Membership function, operation and properties, Fuzzy relations and Crisp relations.

FUZZY SYSTEMS: Crisp Logic, Predicate Logic, Fuzzification, Membership value assignment, Fuzzy Logic, Fuzzy rule-based systems, Defuzzification, Fuzzy applications.

SKILLS:

- ✓ *Customize a suitable model for uncertainty problems.*
- ✓ *Customize a model for the particular problem.*
- ✓ *Identify the Fuzzy relations and Crisp relations.*
- ✓ *Design of various neural networks Architectures*
- ✓ *Evaluate the performance of the given system for available soft computing tools.*

UNIT-2 **12L+0T+8P=20 Hours**

GENETIC ALGORITHM:

Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation, Generational Cycle, applications.

PRACTICES:

- Apply fuzzy logic and reasoning to handle uncertainty and solve various problems
- Apply Fuzzy relations and Crisp relations
- Apply neural networks to pattern classification and regression problems
- Apply genetic algorithms to combinatorial optimization problems
- Evaluate and compare solutions by various soft computing approaches for a given problem.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the different soft computing techniques to medical images	Apply	1	1, 2, 9, 10, 12
2	Apply neural network architectures and learning algorithms, for different problems.	Apply	1	1, 2, 4, 5, 9, 10, 12
3	Apply rough set theory to solve process control applications	Apply	1	1, 2, 3, 4, 5, 9, 10, 12
4	Apply the concept of fuzzy systems to real applications.	Apply	2	1, 2, 4, 9, 10, 12
5	Analyze the genetic algorithms and their applications	Analyze	2	1, 2, 4, 5, 9, 10

TEXT BOOKS:

1. S.N. Sivanandam and S.N. Deepa, “Principles of Soft Computing”, Wiley India Pvt. Ltd, 1st edition, 2011.
2. J.S.R.Jang, C.T. Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, Pearson Education, 2015.

REFERENCE BOOKS:

1. Margarita-Arimatea Díaz-Cortés, Erik Cuevas, Raúl Rojas, “Engineering Applications of Soft Computing” Pearson Education India, 2017.
2. Snehashish Chakraverty, Deepti Moyi Sahoo, Nisha Rani Mahato, “Concepts of Soft Computing-Fuzzy and ANN with Programming” Springer, 2019.
3. Rashid Ali, MM Sufyan Beg, “Applications of Soft Computing for the Web”, Springer, 2017.
4. D. K. Pratihar, “Soft Computing: Fundamentals and Applications”, Alpha Science, 2014.

22BM957 ROBOTICS AND AUTOMATION IN MEDICINE

https://www.ul.com / news/safety- testing- healthcare -robotics

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Biosensors and Transducers.

COURSE DESCRIPTION AND OBJECTIVES:

To provide the basic knowledge on design, analysis, control and working principle of robotics in surgery, rehabilitation and drug delivery (Nano robot).

MODULE–1

UNIT-1 **9L+0T+6P=15 Hours**

INTRODUCTION OF ROBOTICS:

ntroduction to robotics and its history, Overview of robot sub systems, Degrees of freedom, Configurations and concept of workspace, Automation, Mechanisms and Movements, Dynamic stabilization - applications of robotics in medicine.

UNIT-2 **15L+0T+10P=25 Hours**

ACTUATORS AND GRIPPERS:

Pneumatic and hydraulic actuators, Stepper motor control circuits, End effectors, Various types of grippers, Design consideration in vacuum and other methods of gripping, PD and PID feedback actuator models

MANUPULATORS & BASIC KINEMATICS:

Construction of manipulators, Manipulator dynamic and force control, Electronic and pneumatic manipulator, Forward kinematic problems, Inverse kinematic problems, Solutions of inverse kinematic problems.

PRACTICES:

- Demonstration different types of medical robots and their potential applications
- Summarize the principles of sensors, actuators and grippers for robots
- Use the software tools for designing and analyzing the robot motion
- Create stepper motor control circuits
- Design consideration in vacuum and other methods of gripping
- Construction of manipulators and force control system
- Summarize kinematics, dynamics, and control relevant to medical robotics

MODULE-2

UNIT-1 **12L+0T+8P=20 Hours**

POWER SOURCES AND SENSORS:

Sensors and controllers, Internal and external sensors, Position, Velocity and acceleration sensors, Proximity sensors, Force sensors, Laser range finder, Variable speed arrangements, Path determination, Machinery vision, Ranging - laser acoustic, magnetic fiber optic and tactile sensor.

UNIT-2 **12L+0T+8P=20 Hours**

ROBOTICS IN MEDICINE:

Da vinci surgical system, Image robotic systems for focal ultrasound based surgical applications,

SKILLS:

- ✓ *Design and Implement Robotics*
- ✓ *Create a compelling proposal for a new medical robot technology*
- ✓ *Examine concepts in kinematics, dynamics, and control relevant to medical robotics*
- ✓ *Use the software tools for designing and analyzing the robot motion.*

System concept for robotic, Tele surgical system for off pump CABG surgery, Urologic applications, Cardiac surgery, Neuro surgery, Pediatric and general surgery, Gynecologic surgery, General surgery and Nano robotics.

PRACTICES:

- Classify the performance to various sensors to its environment
- Design simple robots for surgical applications
- Apply state of the art in medical robotics and its applications

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply concepts of robotic systems with configuration and mechanism in the medical field	Apply	1	1, 2, 5, 9, 10, 12
2	Apply the various concepts of manipulators, actuators and grippers for robot's system	Apply	1	1, 2, 5, 9, 10, 12
3	Design basic robotics system and formulate Kinematic, Inverse Kinematic motion planning solutions for various Robotic configurations	Create	1	1, 2, 3, 5, 9, 10,1 2
4	Analyze various types of sensors and power sources useful in robotic system design	Analyze	2	1, 2, 4, 9,10, 12
5	Design and develop a Robotic system for Medical application.	Create	2	1, 2, 3, 4, 9, 10, 12

TEXT BOOKS:

1. Andrew J. Kurdila, Pinhas Ben-Tzvi, "Dynamics and Control of Robotic Systems", John Wiley and Sons, 1st edition, 2019.
2. Saeed B. Niku, "Introduction to Robotics: Analysis, Control, Applications",3rd edition, WILEY, 2020.

REFERENCE BOOKS:

1. Jacob Rosen, Blake Hannaford & Richard M Satava, "Surgical Robotics: System Applications & Visions", Springer 2011.
2. Nagrath and Mittal, "Robotics and Control", Tata McGraw-Hill, 1st edition, 2017.
3. Constantinos Mavroidis, Antoine Ferreira, "Nanorobotics: Current approaches and Techniques", Springer 2013.

22BM958 VIRTUAL REALITY

https://appen.com /blog/augmented -and-virtual-reality/

Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Biosensors and transducers.

COURSE DESCRIPTION AND OBJECTIVES:

This course explores the potential of a virtual world for delivering application, determine possible instructional designs, understand the limitations, understand the barriers, solutions, and costs associated and including required training.

MODULE - I

UNIT-1 **9L+6T+0P=15 Hours**

INTRODUCTION:

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 and haptic feedback.

UNIT-2 **15L+10T+0P=25 Hours**

MODELING:

Geometric modeling, Kinematics modeling, Physical modeling, Behaviour modeling, Model management.

PRACTICES:

- Demonstration virtual reality-commercial VR technology
- Summarize the principles of Trackers, Navigation, and Gesture Interfaces
- Use the software tools for Modeling Geometric, Kinematics and Physical
- Design consideration in VR technology
- Construction of manipulators and force control system
- Summarize output Devices- Graphics displays, sound displays and haptic feedback.

MODULE-2

UNIT-1 **12L+8T+0P=20 Hours**

HUMAN FACTORS:

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-2 **12L+8T+0P=20 Hours**

VR PROGRAMMING:

Introducing Java 3D, Loading and manipulating external models using a lathe to make shapes; 3DSprites, Animated 3D sprites-particle systems.

APPLICATIONS:

Medical applications, Military applications, Robotics applications, Advanced Real Time Tracking, Other applications, Games, Movies, Simulations, Therapy.

SKILLS:

- ✓ *Understand the concepts of components of virtual reality.*
- ✓ *Analyze the geometric modelling for systems*
- ✓ *Human factors involved in the acquisition systems*
- ✓ *Application of virtual reality for robotics*
- ✓ *Calculation of side effects of virtual reality*

PRACTICES:

- Design of VR technology relates to human perception and cognition
- Design and implement rigorous empirical experiments using VR
- Experience with using virtual environment technology in medical applications
- Designing and implementing rigorous empirical experiments using VR for medical applications

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the state- of- art design and utilize VR technical resources to the conduct of scientific research	Apply	1	1, 2, 3, 4, 9, 10, 12
2	Design of VR technology relates to human perception and cognition	Create	1	1, 2, 3, 4, 5, 9, 10
3	Create virtual environment technology, including 3D rendering software, tracking hardware, and input/output functions for capturing user data.	Create	1	1, 2, 4, 5, 9, 10
4	Apply the software tools to make shapes; 3D sprites, animated 3D sprites-particle systems	Apply	2	1, 2, 4, 5, 9, 10, 12
5	Designing and implementing rigorous empirical experiments using VR for medical applications	Create	2	1, 2, 3, 4, 9, 10, 12

TEXT BOOKS:

1. Matjaž Mihelj, Domen Novak, Samo Beguš, “Virtual Reality Technology and Applications”, 2nd edition, Springer,2014.
2. William R.Sherman, Alan Craig, “Understanding Virtual Reality, interface, Application and Design”, Elsevier, Morgan Kaufmann, 2018.

REFERENCE BOOKS:

1. Bill Fleming,”3D Modeling and surfacing”, Elsevier, Morgan Kauffman, 2021.
2. David H.Eberly, “3D Game Engine Design Practical Approach to Real-Time Computer Graphics”, Elsevier, 2017.
3. John Vince, “Virtual Reality Systems”, Pearson Education, 2017.
4. Andrew Davison, “Killer Game Programming in Java”, 2nd edition, Oreilly SPD, 2015.

MINORS

BIOMEDICAL ENGINEERING

B.Tech.

22BM901	-	Clinical Instrumentation
22BM902	-	Diagnostic and Therapeutic Equipments
22BM903	-	Biomedical Signal Processing
22BM904	-	Medical Imaging Modalities
22BM905	-	Medical Image Processing

COURSE CONTENTS

I SEM & II SEM

22BM901 CLINICAL INSTRUMENTATION

https://www.google.com /search?q=basic+clinical+sciences&sxsrf=

Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Fundamentals of Anatomy & Physiology.

COURSE DESCRIPTION AND OBJECTIVES:

This course includes the basic and advanced principles, concepts, and operations of medical sensors and devices, the origin and nature of measurable physiological signals and also including design of electronic instrumentation. This course aimed to impart the knowledge of realistic design and experimentation with clinical measurement.

MODULE–1

UNIT-1 **9L+6T+0P=15 Hours**

NEPHROLOGY: Principles and types of dialysis, Components of dialyzing system, Dialysate, Composition of dialysate, Types of dialyzers, Clinical significance, Renal transplantation

GASTROENTEROLOGY: G.I.T diseases - stomach (ulcers), liver (jaundice), gall bladder (gall stone), Instruments used in gastroenterology Disease diagnosis and treatment. Laparoscopy, Endoscopy and intubation tubes.

PATHOLOGY& BLOOD BANK: ESR, Electrolyte estimation of normal values, HIV test - ELISA, dot method, cross matching of blood, cell counter.

UNIT-2 **15L+10T+0P=30 Hours**

MEDICAL ANALYTICAL INSTRUMENTATION: Methods of chemical analysis, Absorption photometry, Emission photometry, Flurometry, Colorimeter, Spectrophotometer, Flame photometer, Mass spectrophotometer, Chromatography, Blood gas analyzer, Semi and fully automated analyzers.

PRACTICES:

- Design a proto type of reusable and Portable dialyzer.
- Distinguish different diagnostic test process of gastrointestinal disorders.
- Evaluate the Instruments used in gastroenterology.
- Evaluate the Laparoscopy, Endoscopy and intubation tubes.
- Determination the ESR/ELISA/blood cell counting using microscope.
- Colorimeter, Spectrophotometer, Electrophoresis

MODULE-2

UNIT-1 **12L+8T+0P=20 Hours**

MEDICAL INSTRUMENTATION: Block diagram; Bio-signals: Bio potentials-ECG, EEG, EGG, EMG, ENG, EOG, and ERG; Electrode - electrolyte interface, half-cell potential, offset voltage; Types of Electrodes - external, internal and microelectrodes.

CARDIAC INSTRUMENTATION: ECG block diagram and circuits, Electrodes and their placement; Lead configuration and ECG waveforms; ECG monitors - single and multi-channel ECG systems, Holter monitors, stress test systems.

UNIT-2 **12L+8T+0P=20 Hours**

NEURO-MUSCULAR INSTRUMENTATION: EEG block diagram and circuits, Electrodes placement,

SKILLS:

- ✓ *Demonstration of instruments and kidney transplantation*
- ✓ *Analyse the various diseases and their appearances.*
- ✓ *Determine the physics behind diagnostic instruments.*
- ✓ *Application of Pre and Post-operative care procedures*
- ✓ *Identify different disease and symptoms*

Lead configuration and EEG graphs; Evoked potentials, Filters for EEG rhythm analysis, EMG - EMG block diagram and circuits, Electrodes placement.

PRACTICES:

- Design of Instrumentation amplifiers for ECG/ EEG/ EMG.
- Design of filters for ECG/ EMG/ EEG.
- Apply Holter monitors technique to ECG
- Demonstrate wet, dry and gel electrode configurations using Impedance analyzer.
- ECG, EEG and EMG signals acquire and analyze by using simulator and real time
- Develop and apply equivalent circuits for biomedical instruments

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the concepts of dialysis to analyse the performance of dialysis of treatment and design of dialyzer	Apply	1	1, 2, 9, 10, 12
2	Apply the volume conductor principles to interpret ECG waves and suggest cardiac assist devices	Apply	2	1, 2, 4, 6 9, 10, 12
3	Design hardware and software tools/ methods to analyse biological signals	Analyze	2	1, 2, 5, 6, 9, 10, 12
4	Evaluate the properties of biological samples using various medical analytical instrumentation.	Analyze	1	1, 2, 4, 6, 9, 10, 12
5	Analyse the diseases of the GI tract and instruments used for diagnosis. Categorize the blood transfusion compatibility based on grouping and other important factors using the blood cell counters/ESR/ELISA	Evaluate	1	1, 2, 4, 5, 9, 10, 12

TEXTBOOKS:

1. Webster J.G., “Medical Instrumentation Application and Design”, 4th edition, Houghton Mifflin, 2015.
2. Khandpur R.S. “Hand Book of Biomedical Instrumentation”, 3rd edition, Tata McGraw-Hill, 2014.

REFERENCEBOOKS:

1. Carr and Brown, “Introduction to Biomedical Equipment Technology”, 4th edition, Pearson, 2012.
2. Lurence J Street, “Introduction to Biomedical engineering technology”, 3rd edition, Taylor & Francis -Hill, 2016.
3. John Enderle, Susan M. Blanchard, and Joseph Bronzino, “Introduction to Biomedical Engineering”, 2nd edition, 2015.

22BM902 DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS

https://depositphotos.com /100760536/ stock-photo-advance-ultrasound-machine-in- hospital.html

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Analog circuits, Analog and linear ICs.

COURSE DESCRIPTION AND OBJECTIVES:

This course explains the concepts about human-instrument system and problems encountered in obtaining measurements from a living body. It also deals with basics of measuring the parameters in respiratory system, learn measurement techniques of sensory responses and understand different types and uses of diathermy units. It also gives knowledge of ultrasonic therapeutics and diagnosis.

MODULE –1

UNIT-1 **9L+0T+6P=15 Hours**

PATIENT MONITORING SYSTEMS:

Special care units, ICU/CCU equipments, Bed side patient monitoring systems – multi-parameters, measurement of heart rate and pulse rate, Holter monitor, phonocardiography, plethysmography, recording system; Oximeters -principle, intravascular oximeter; Cardiotacograph, Methods of monitoring foetal heart rate, Monitoring labour activity, Baby incubator.

UNIT-2 **15L+0T+10P=25 Hours**

DIATHERMY:

Short wave diathermy, Ultrasonic diathermy, Microwave diathermy, Electro surgery machine - current waveforms, tissue responses, electrosurgical current level, surgical diathermy analyzers, hazards and safety procedures.

AUTOMATED DRUG DELIVERY SYSTEMS: Infusion pumps, Components of drug infusion pumps, Implantable infusion systems, Closed loop control in infusion systems, Programmable controlled insulin dosing device.

PRACTICES:

- Multipara meter monitoring system.
- Heart sound measurement using phonocardiography
- Design Cardiotacometer
- Design phonocardiography
- Design Patient monitoring system
- Shortwave diathermy
- Ultrasonic diathermy
- Long wave diathermy
- Inspection ESU – cutting and coagulation modes.
- Design syringe and Infusion Pumps

MODULE-2

UNIT-1 **12L+0T+8P=20 Hours**

EXTRA CORPOREAL DEVICES AND THERAPEUTIC TECHNIQUE:

Lithotripsy - Stone Disease Problem, First Lithotripter Machine, Modern Lithotripter Systems; Extracorporeal Shockwave Therapy, Principles of Cryogenic Technique and Application, Thermotherapy,

SKILLS:

- ✓ *Differentiate various instruments in hospitals for trouble shooting*
- ✓ *Determine diagnostic techniques used in health care.*
- ✓ *Investigate the breakdown of diagnostic and therapeutic equipments.*
- ✓ *Evaluate the procedures for safely carrying out therapeutic process*

Hyperthermia, High Intensity Focused Ultrasound (HIFU), Thermography – Recording and Clinical Application.

UNIT-2 **12L+0T+8P=20 Hours**

ELECTRICAL SAFETY:

Physiological effects of electricity, Importance susceptibility parameters, Distribution of electric power, Macro shock hazards, Microshock hazards, Electrical - safety codes and standards, protection against shock; Protection - electrical safety analyzers, testing electric system, tests of electric appliances, problems.

PRACTICES:

- Predict the thermal effects of tissue by operation of Hyperthermia through simulation
- Predict the thermal effects of tissue by operation of High intensity focused ultrasound therapy simulation
- Electrical safety measurements
- Examine the Protection of electrical safety issue of instruments

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Classify critical equipment into various units	Analyze	1	1, 2, 9, 10
2	Distinguish the different diathermy equipment by applying physics laws and Evaluate the diathermy units to estimate the treatment plans.	Analyze	1	1, 2, 4, 5, 9, 10
3	Design the components and working of drug delivery systems	Analyze	1	1, 2, 3, 5, 9, 10, 12
4	Apply ultrasound physics to realize the treatment of kidney stones, cancer	Analyze	2	1, 2, 4, 9, 10
5	Evaluate the electrical safely carrying out therapeutic devices in hospitals	Evaluate	2	1, 2, 4, 5, 9, 10

TEXT BOOKS:

1. Khandpur R.S, “Handbook of Biomedical Instrumentation”, 3rd edition, Tata McGraw Hill, 2014.
2. Leslie Cromwell, “Biomedical Instrumentation and Measurement”, 4rd edition, Prentice Hall, 2015.

REFERENCES BOOKS:

1. John G. Webster, “Medical Instrumentation Application and Design”, 4th edition, John Willey and Sons, 2015.
2. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, 4th edition, Pearson Education, 2004.
3. L.A Geddas and L.E.Baker, “Principles of Applied Biomedical Instrumentation”, 3rd edition, 2017.
4. Myer Kutz “Standard Handbook of Biomedical Engineering and Design”, McGraw-Hill Publisher, 2013.

22BM903 BIOMEDICAL SIGNAL PROCESSING

https://usharama.edu.in /blogDetail/biomedical- signal-processing

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Signals and Systems.

COURSE DESCRIPTION AND OBJECTIVES:

This course presents relationships among different theoretical measures of biomedical signals and an understanding of the information. Biomedical engineering involves the application of engineering methods for the improvement of human health; the signals encountered by biomedical engineers are typically derived from biological processes. This course imparts the knowledge of signal processing of all bio-potentials and their corresponding transforms.

MODULE-1

UNIT-1 **15L+0T+10P=25 Hours**

FUNDAMENTALS OF DISCRETE-TIME SIGNALS AND SYSTEMS:

Concepts of systems and signal, Z-transform, Discrete Fourier transform (DFT), Fast Fourier transform(FFT), Medical applications.

BIOMEDICAL SIGNAL:

Biomedical signal origin, Dynamics ECG, EEG, EMG signal and its characteristics, Filtering for removal of artifacts; Statistical preliminaries - random noise, structured noise, stationary vs non stationary processes; Time domain filtering (synchronized averaging, moving average).

UNIT-2 **9L+0T+6P=15 Hours**

ELECTROCARDIOGRAM (ECG):

Heart rhythms, Heart beat morphologies, Noise and artifacts, Base line wander, Power line interference, Muscle noise filtering, QRS detection, Wave delineation, Data compression, Heart rate variability, Spectral analysis of heart rate variability.

PRACTICES:

- Find the output y(n) for an input x(n), for the discrete time system represented by impulse response h(n).
- Compute Linear Convolution and circular for two sequences.
- Compute the Discrete Fourier Transform and IDFT with and without FFT and IFFT
- Implementation of Decimation-in-time / Decimation-in-frequency radix-2 FFT algorithm.
- Find the Fourier transform, frequency response of x(n), and plot its magnitude and phase.
- Compute the Discrete Fourier Transform and IDFT with and without FFT and IFFT.
- Data polishing removal of power line interface from ECG
- Display static and moving ECG signal
- Spectrum analysis of ECG Signals.
- Detect QRS complex and measure the heart rate of a given ECG signal

MODULE-2

UNIT-1 **12L+0T+8P=20 Hours**

ELECTROENCEPHALOGRAM(EEG):

SKILLS:

- ✓ *Analyze different biopotential signals using Lab View/MATLAB.*
- ✓ *Test and design a stable system (ECG, EMG, EEG kit).*
- ✓ *By deeply understating the physiological signals and systems can design different*
- ✓ *vital monitoring systems.*

Applications, Modeling - deterministic and stochastic properties, linear, stochastic models, nonlinear modeling of the EEG; Artifacts - artifacts characteristics, artifact cancellation using linearly combined reference signals, adaptive artifact cancellation using linearly combined reference signals; Noise reduction by ensemble averaging, Nonparametric and model based spectral analysis, EEG segmentation, Evoked potential modalities.

UNIT-2 **12L+0T+8P=20 Hours**

ELECTROMYOGRAM (EMG):

The electrical activity of muscles, Amplitude estimation in the surface EMG, Spectral analysis of the surface EMG, Conduction velocity estimation, Modeling the EMG, EMG signal decomposition.

PRACTICES:

- Classification of EEG signals and analysis.
- Detection of EEG rhythms, Template matching for EEG, spike and wave detection
- Removal of Artifacts in the EEG
- Removal of Artifacts in the EMG
- EEG rhythms, waves, and transients
- Analysis of EMG Signals

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply basic concepts of discrete time biomedical signals and systems	Apply	1	1, 2, 4, 5, 9, 10
2	Apply filters and averaging techniques to remove noise and extract features of biomedical signals, also to evaluate performance of algorithms	Apply	1	1, 2, 5, 9, 10
3	Develop simple algorithms and Evaluate performance of ECG, EMG and EEG that will serve the basis in career	Analyze	1	1, 2, 3, 5, 9, 10 ,12
4	Analyze the biomedical signals ECG, EMG and EEG and its interpret the nature	Apply	2	1, 2, 5, 9, 10
5	Verify various transform techniques and filters and evaluate the physiological signals by applying signal processing techniques using Matlab.	Evaluate	2	1, 2, 4, 5, 9, 10, 12

TEXT BOOKS:

1. N.Vyas, “Biomedical Signal Processing”, University Science Press, New Delhi, 2014.
2. Rangaraj M. Rangayyan, Akay Metin (Editor), “Biomedical Signal processing”, 1st edition, IEEE Press, 2014.

REFERENCE BOOKS:

1. Leif Sornmo and Pablo Laguna, “Bioelectrical Signal Processing in Cardiac and Neurological applications”, 3rd edition, Academic Press, 2005.
2. Mahesh Kumar H.Kolekar, “Biomedical Signal and Image Processing in patient care ”, IG Globl, 2017.
3. Ganesh Naik, “Biomedical Signal Processing- Advances in theory, Algorithms and Applications, Springer, 2020.

22BM904 MEDICAL IMAGING MODALITIES

https://openmedscience.com/medical-imaging/

Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Engineering Physics, signals and systems, Biomedical Instrumentation.

COURSE DESCRIPTION AND OBJECTIVES:

This course studies the image reconstruction techniques, quality assurance test for radiography, method of recording sectional image, functioning of radioisotopic imaging equipment and the MRI, image acquisition and reconstruction, it also explains the 3-D image display techniques. This course aimed at imparting knowledge of operation and medical applications of the major medical imaging techniques.

MODULE - 1

UNIT-1 **12L+8T+0P=20 Hours**

INTRODUCTION:

X-ray, CT, Ultrasound, MRI, PET-CT, SPECT-CT, Gamma Camera, Catheterization Lab. Image perception, Image acquisition, Display, Image processing operations, scanning.

X-RAY: X-Ray imaging, Fundamentals of X-ray, Electromagnetic radiation, Interactions between X-rays and matter, Intensity of X-ray beam, Attenuation, Generation and detection of X-rays, biological effects of ionizing radiation; X-Ray diagnostic methods - conventional X-ray radiography, fluoroscopy, angiography, mammography and xeroradiography.

CT: Conventional tomography, Computed tomography - projection function, algorithms for image reconstruction, multiplanar reconstruction, non-spiral CT technology, concepts of spiral CT scanner, multi slice spiral technology, Recent applications – CT angio, cardiac CT, dual energy CT.

UNIT-2 **12L+8T+0P=20 Hours**

ULTRASOUND IMAGING:

Fundamentals of acoustic propagation - characteristic impedance, intensity, reflection and refraction, attenuation, Doppler effect; Generation and detection of Ultrasound - piezoelectric effect, ultrasonic transducers.

ULTRASONIC DIAGNOSTIC METHODS:

Pulse echo systems - amplitude mode (A-mode), brightness mode (B-mode), motion mode (M-mode), 3D, 4D, Doppler methods, duplex imaging, colour Doppler flow imaging, image artifact, biological effects of ultrasound.

PRACTICES:

- Analyse the radiation exposure to patients by using low kV values
- Evaluate the prevention of unnecessary exposure to patients in digital radiography
- Evaluate the rejection analysis in radiography reduce unnecessary exposure to patients
- Determines the Quality of the chemical processing of radiographic film have any effect on the radiation exposure of a patient
- Determines the radiation dose to the breast of patients in mammography
- Determines the radiation exposure to a patient affected by the size of the image
- Apply the reconstruction techniques of the CT images for generation of image
- Analysis the radiation doses to patients undergoing cardiac CT procedures compare to doses from other radiographic procedures
- Design and Develop the ultrasound transducer

SKILLS:

- ✓ *Study the physics behind medical imaging.*
- ✓ *Determine the basis for an image is formation.*
- ✓ *Know the image formation in MRI.*
- ✓ *Grasp the knowledge of CT and importance of a medical department.*
- ✓ *Image acquisition and processing of images for required model.*
- ✓ *Integration of CT_PET for structural and functional analysis of disease.*
- ✓ *Calculate dose limits and differentiate between controlled areas and radiation hazards.*

- Determines the ultrasound modes for examine the diseases

MODULE-2

UNIT-1 **12L+8T+0P=20 Hours**

MAGNETIC RESONANCE IMAGING:

Basics of magnetic resonance imaging, Fundamentals of nuclear magnetic resonance - angular momentum, magnetic dipole moment, magnetization, larmour frequency, free induction decay (FID), Fourier spectrum of the NMR signal, spin density, relaxation times, pulse sequences.

MRI SYSTEM & IMAGING METHODS:

Introduction, Magnet, NMR Coil/Probe, Transmitter, Receiver, Data acquisition; Imaging methods - introduction, slice selection, frequency encoding, phase encoding, spin-echo imaging, gradient echo imaging; Characteristics of MRI images - spatial resolution, image contrast, biological effects of magnetic fields, static magnetic fields, radiofrequency fields, gradient magnetic fields, imaging safety, functional MRI (brief introduction only).

UNIT-2 **12L+8T+0P=20 Hours**

NUCLEAR IMAGING:

Physics of gamma camera, Basic instrumentation, Imaging techniques, SPECT and whole body studies; Applications of gamma camera in cardiology, Nephrology, Neurology etc., PET - fundamentals of PET scanner and PET- CT, crystal technology, cyclotron principle, Applications of PET - cardiology, neurology and cardiology.

PRACTICES:

- Analysis the MRI compare with doses from other examinations.
- Determine the reconstruction techniques of the MRI images for generation of image
- Analysis the PET/CT radiation doses compare with doses from other examinations.
- Determine the patient exposure PET/CT radiation given in an examination
- Determine the optimize image quality in a gamma camera examination
- Determine the optimization in diagnostic nuclear medicine

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyse the CT image reconstruction techniques using different algorithms.	Analyze	1	1, 2, 3, 4, 9, 10
2	Apply the concepts of ultrasound image formation model and analyse the biological effects.	Apply	1	1, 2, 5, 9, 10, 12
3	Identify MRI pulse sequences & hardware systems for tissues imaging and its hardware.	Analyze	1	1, 2, 4, 5, 9, 10, 12
4	Analyse the nuclear spins and the decay systems of NMR.	Analyze	2	1, 2, 4, 5, 9, 10, 12
5	Analyse the SPECT- PET imaging formation techniques in cardiology and neurology.	Analyze	2	1, 2, 4, 5, 9, 10

TEXT BOOKS:

1. Kirk Shung, Michael B. Smith and Banjamin Tsui, “Principles of Medical Imaging”, Academic Press, 2015.
2. Paul Suetens, “Fundamentals of Medical Imaging”, 3rd edition, Cambridge University Press, 2017.

REFERENCE BOOKS:

1. Michael Chappell, “Principles of Medical Imaging for Engineers”, Springer, 2019.

22BM905 MEDICAL IMAGE PROCESSING

https://miro.medium.com/max/600/1*CG8POmsTy2h6rzDQsbDPzA.jpeg

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Medical Imaging Techniques, Biomedical Signal Processing.

COURSE DESCRIPTION AND OBJECTIVES:

This course imparts the working knowledge of medical image processing, various techniques of transformation, enhancement, restoration, compression, segmentation and image morphology. The course gives the knowledge of all kinds of image processing in biomedical applications.

MODULE–1

UNIT-1 **9L+0T+6P=15 Hours**

IMAGE FUNDAMENTALS:

Introduction, Steps in digital image processing, Components, Elements of visual perception, Image sampling and quantization, Relationships between pixels, Color models.

IMAGE ENHANCEMENT:

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.

UNIT-2 **15L+0T+10P=25 Hours**

IMAGE RESTORATION:

Noise models, Mean filters, Order statistics, Adaptive filters, Band reject filters, Band pass filters, Notch filters, Optimum notch filtering, Inverse filtering, Wiener filtering.

PRACTICES: USING MATLAB / PYTHON:

- Determine Image sampling and quantization
- Analysis of spatial and intensity resolution of images
- Determine Intensity transformation of images.
- Analysis of images with different color models
- Histogram processing.
- Image enhancement spatial filtering.
- Image enhancement filtering in frequency domain
- Image filtering -Adaptive filters, Band reject filters, Band pass filters, Notch filters, Optimum notch filtering, Inverse filtering, Wiener filtering.
- Analysis of images with different color models.

MODULE-2

UNIT-1 **12L+0T+8P=20Hours**

THRESHOLDING AND SEGMENTATION:

Detection methods, Optimal thresholding, Multi-spectral thresholding; Edge based segmentation, Region based segmentation, Matching, Advanced optimal border and surface detection approaches, thresholding, applications – US, MRI, CT images.

SKILLS:

- ✓ *Process medical images using different techniques.*
- ✓ *Diagnose abnormalities in a given health problem relative to imaging.*
- ✓ *Gain knowledge to write or device their own model for specifically pertaining problems*
- ✓ *Critically understand the mathematics behind image processing*

IMAGE REPRESENTATION AND RECOGNITION:

Boundary representation - chain code, polygonal approximation, signature, boundary segments, boundary description, shape number, Fourier descriptor, moments regional descriptors, topological feature; Texture - patterns and pattern classes, recognition based on matching.

UNIT-2 **12L+0T+8P=20 Hours**

MATHEMATICAL MORPHOLOGY:

Basic morphological concepts, Morphological principles: Binary dilation and erosion, Gray scale dilation and erosion, skeletons and object marking, graundometry, Morphological segmentation and water sheds; Applications of image processing techniques to MRI Images, Dicom, CT and Functional MRI images.

PRACTICES:

- Image segmentation edge detection, line detection and point detection.
- Region based image segmentation
- Thresholding based image segmentation
- Basic morphological operations.
- Morphological segmentation and water sheds

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the various transforms to enhance images in frequency domain	Apply	1	1, 2, 9, 10, 12
2	Apply image segmentation and restoration techniques to US,CT,MRI images	Apply	2	1, 2, 5, 9,10, 12
3	Analyze the techniques for image representation.	Analyze	1	1, 2, 5, 9, 10, 12
4	Apply the techniques of mathematical morphology useful for image processing	Apply	2	1, 2, 5 9, 10, 12
5	Develop program for processing a medical image by various algorithms for different applications	Creative	2	1, 2, 3 ,4, 9, 10

TEXT BOOKS:

1. Rafael C, Gonzalez, Richard E. Woods, Steven Eddins, “Digital Image Processing using MATLAB”, Pearson Education, Inc., 3rd edition, 2020.
2. Jayaram, Kudupa and Gabor, T Herman, “3D imaging in medicine”, 2nd edition, CRC press, 2000.

REFERENCE BOOKS:

1. Milan Sonka, Vaclav Hlavac and Roger Boyle, “Image processing, analysis and machine vision, 4th edition, Brooks/Cole Publishing Co., 2014.
2. John C Russ, “The image processing handbook”, 6th edition, CRC and IEEE press, 2011.
3. Milan Sonka, “Digital Image Processing and Computer Vision”, 3rd edition, India edition, 2013.

OPEN ELECTIVES

BIOMEDICAL ENGINEERING

B.Tech.

22BM851	-	Basic Clinical Sciences
22BM852	-	Biomedical Instrumentation
22BM853	-	Diagnostic and Therapeutic Equipments
22BM854	-	Medical Imaging Modalities
22BM855	-	Biomaterials
22BM856	-	Biomechanics

COURSE CONTENTS

I SEM & II SEM

22BM851 BASIC CLINICAL SCIENCES

https://www.google.com / search?q=basic +clinical+ sciences& sxsrf=

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Fundamentals of Anatomy & Physiology.

COURSE DESCRIPTION AND OBJECTIVES:

A clinical science gives a perceptive to students on various aspects of clinical diseases and the measurable parameters for diagnosis and gives a view on instruments for treatment and other assistive devices.

MODULE–1

UNIT-1 **6L+6T+0P=12 Hours**

NEPHROLOGY: Principles and types of dialysis, Components of dialyzing system, Dialysate, Composition of dialysate, Types of dialyzers, Clinical significance, Renal transplantation

UNIT-2 **10L+10T+0P=20 Hours**

NEUROLOGY: Diseases of nervous system (Alzheimer's disease, Parkinson's disease, ALS), Spinal cord lesions, Motor nervous disease, Prolapsed intervertebral disc, Neuropathies, Myasthenia gravis, Diseases of muscle - myopathy.

PRACTICES:

- Design a proto type of reusable dialyzer
- Design a Portable dialyzer
- Records the brain's continuous electrical activity through electrodes attached to the scalp.
- Records the brain's electrical response to visual, auditory, and sensory stimuli
- Case Study: Critical analysis of the symptomatic and asymptomatic symptoms of Alzheimer's disease, Parkinson's disease, ALS.

MODULE-2

UNIT-1 **8L+8T+0P=16 Hours**

GASTROENTEROLOGY: Anatomy and physiology and G.I.T diseases - stomach (ulcers), liver (jaundice), gall bladder (gall stone); Disease diagnosis and treatment, Juices-Gastric, Bile, Pancreatic, Intestinal, functions and clinically significant symptoms - signs, diseases, Instruments used in gastroenterology.

UNIT-2 **8L+8T+0P=16 Hours**

GENERAL SURGERY: Clinically significance, Preoperative care, Postoperative care, Study of operation of surgical equipment, Laparoscopy, Endoscopy and intubation tubes.

PATHOLOGY& BLOOD BANK: Blood Groups, ESR, ELISA -HIV test, dot method, cross matching of blood, cell counter, normal blood coagulation factors.

PRACTICES:

- Distinguish different diagnostic test process of gastrointestinal disorders.
- Evaluate the Instruments used in gastroenterology.
- Case Study: Pre and Postoperative care of cancer patient.
- Evaluate the Laparoscopy, Endoscopy and intubation tubes.
- Determination the ESR/ELISA/blood cell counting (dot/cross matching method) using microscope.

SKILLS:

- ✓ *Demonstration of instruments and kidney transplantation*
- ✓ *Analyse the various diseases and their appearances.*
- ✓ *Determine the physics behind diagnostic instruments.*
- ✓ *Application of Pre and Post-operative care procedures*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the concepts of dialysis to analyse the performance of dialysis of treatment and design of dialyzer	Apply	1	1, 2, 9, 10, 12
2	Apply the conditions and symptoms for identification of neurological diseases	Apply	1	1, 2, 5, 9, 10, 12
3	Analyse the diseases of the GI tract and instruments used for diagnosis.	Analyze	2	1, 2, 4, 5, 9, 10,12
4	Analyse the conditions of patient in pre and post-operative cares of patient	Analyze	2	1, 2, 4, 9, 10, 12
5	Categorize the blood transfusion compatibility based on grouping and other important factors using the blood cell counters/ESR/ELISA	Evaluate	2	1, 2, 4, 5, 9, 10

TEXTBOOKS:

1. Elaine.N.Marieb, “Essential of Human Anatomy and Physiology”,12th edition, Pearson Education, 2017.
2. Gerard J. Tortora, Bryan D. “Principles of Anatomy and Physiology”, 14thedition, John Wiley & Sons INC, 2014

REFERENCEBOOKS:

1. Michael Zigmond, Joseph Coyle, Lewis Rowland, “Neurobiology of Brain Disorders”, Academic Press, 2014.
2. Jeffrey A. Morgan, Andrew B. Civitello, O.H. Frazier, “Mechanical Circulatory Support for Advanced Heart Failure”, Springer, 2018.
3. Jones DB, Wu JS, Soper NJ, “Laproscopic surgery: Principles and Procedures”, 2nd edition, Marcel Dekker, 2019.

22BM852 BIOMEDICAL INSTRUMENTATION

https://www.info 4eee.com/2014 /04/ introduction -to-biomedical.html

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Signals and Systems, Analog and Digital Electronics.

COURSE DESCRIPTION AND OBJECTIVES:

This course includes the basic and advanced principles, concepts, and operations of medical sensors and devices, the origin and nature of measurable physiological signals and also including design of electronic instrumentation. This course aimed to impart the knowledge of realistic design and experimentation with amplifiers for biopotential measurement.

MODULE –1

UNIT-1 **6L+0T+6P=12 Hours**

MEDICAL INSTRUMENTATION:

Block diagram; Bio-signals: Bio potentials-ECG, EEG, EGG, EMG, ENG, EOG, and ERG; Problems encountered with measurements from human beings; specifications, Electrode - electrolyte interface, half-cell potential, offset voltage; Types of Electrodes - external, internal and microelectrodes; Mathematical treatment of electrodes – equivalent circuits and applications.

UNIT-2 **10L+0T+10P=20 Hours**

CARDIAC INSTRUMENTATION:

ECG block diagram and circuits, Electrodes and their placement; Lead configuration and ECG waveforms; ECG monitors - single and multi-channel ECG systems, Holter monitors, stress test systems. Blood flow measurement electromagnetic and ultrasonic techniques; Phonocardiography, Cardiac Pacemaker.

PRACTICES:

- Demonstrate wet, dry and gel electrode configurations using Impedance analyzer.
- ECG, EEG and EMG signals acquire and analyze by using simulator and real time
- Develop and apply equivalent circuits for biomedical instruments

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

NEURO-MUSCULAR INSTRUMENTATION:

EEG block diagram and circuits, Electrodes placement, Lead configuration and EEG graphs; Evoked potentials, Filters for EEG rhythm analysis, EMG - EMG block diagram and circuits, Electrodes placement; NCV, Stimulators for EMG recording.

UNIT-2 **8L+0T+8P=16 Hours**

MEDICAL ANALYTICAL INSTRUMENTATION:

Methods of chemical analysis, Absorption photometry, Emission photometry, Flurometry, Colorimeter, Spectrophotometer, Flame photometer, Mass spectrophotometer, Chromatography, Blood gas analyzer, Semi and fully automated analyzers.

SKILLS:

- ✓ *Study of biomedical instrumentation and their parameters.*
- ✓ *Study of different display devices.*
- ✓ *Determination of bio potentials and how they are interpreted.*
- ✓ *Extraction of biological signals and feeding them to instruments to make meaning out of it.*

PRACTICES:

- Design of Instrumentation amplifiers for ECG/ EEG/ EMG.
- Design of filters for ECG/ EMG/ EEG.
- Apply Holter monitors technique to ECG
- Colorimeter.
- Spectrophotometer.
- Electrophoresis

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Determine the characteristics of biopotentials	Analyze	1	1, 2, 4, 5, 9, 10, 12
2	Apply the volume conductor principles to interpret ECG waves and suggest cardiac assist devices	Apply	1	1, 2, 5, 9, 10, 12
3	Analyse the recording of neuro muscular signals	Analyze	1	1, 2, 5, 9, 10, 12
4	Design hardware and software tools/ methods to analyse biological signals	Creative	2	1, 2, 3, 4, 9, 10, 12
5	Evaluate the properties of biological samples using various medical analytical instrumentation.	Evaluate	2	1, 2, 4, 5, 9, 10

TEXT BOOKS:

1. Webster J.G., “Medical Instrumentation Application and Design”, 4th edition, Houghton Mifflin, 2015.
2. Khandpur R.S. “Hand Book of Biomedical Instrumentation”, 3rd edition, Tata McGraw-Hill, 2014.

REFERENCES BOOKS:

1. Carr and Brown, “Introduction to Biomedical Equipment Technology”, 4th edition, Pearson, 2012.
2. Lurence J Street, “Introduction to Biomedical engineering technology”, 3rd edition, Taylor & Francis -Hill, 2016.
3. John Enderle, Susan M. Blanchard, and Joseph Bronzino, “Introduction to Biomedical Engineering”, 2nd edition, 2015.

22BM853 DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS

https://depositphotos.com/100760536/stock-photo- advance-ultrasound-machine-in-hospital.html

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Analog circuits, Analog and linear ICs.

COURSE DESCRIPTION AND OBJECTIVES:

This course explains the concepts about human-instrument system and problems encountered in obtaining measurements from a living body. It also deals with basics of measuring the parameters in respiratory system, learn measurement techniques of sensory responses and understand different types and uses of diathermy units. It also gives knowledge of ultrasonic therapeutics and diagnosis.

MODULE-1

UNIT-1 **6L+0T+6P=12 Hours**

PATIENT MONITORING SYSTEMS:

Special care units, ICU/CCU equipments, Bed side patient monitoring systems – multi-parameters, measurement of heart rate and pulse rate, Holter monitor, phonocardiography, plethysmography, recording system; Oximeters -principle, intravascular oximeter; Cardiotacograph, Methods of monitoring foetal heart rate, Monitoring labour activity, Baby incubator.

UNIT-2 **10L+0T+10P=20 Hours**

DIATHERMY:

Short wave diathermy, Ultrasonic diathermy, Microwave diathermy, Electro surgery machine - current waveforms, tissue responses, electrosurgical current level, surgical diathermy analyzers, hazards and safety procedures.

PRACTICES:

- Multipara meter monitoring system.
- Heart sound measurement using phonocardiography
- Design Cardiotacometer
- Design phonocardiography
- Design Patient monitoring system
- Shortwave diathermy
- Ultrasonic diathermy
- Long wave diathermy
- Inspection ESU – cutting and coagulation modes.
- Design syringe and Infusion Pumps

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

EXTRA CORPOREAL DEVICES AND THERAPEUTIC TECHNIQUE:

Lithotripsy - Stone Disease Problem, First Lithotripter Machine, Modern Lithotripter Systems; Extracorporeal Shockwave Therapy, Principles of Cryogenic Technique and Application, Thermotherapy, Hyperthermia, High Intensity Focused Ultrasound (HIFU), Thermography – Recording and Clinical Application.

SKILLS:

- ✓ *Differentiate various instruments in hospitals for trouble shooting*
- ✓ *Determine diagnostic techniques used in health care.*
- ✓ *Investigate the breakdown of diagnostic and therapeutic equipments.*
- ✓ *Evaluate the procedures for safely carrying out therapeutic process*

UNIT-2 **8L+0T+8P=16 Hours**

ELECTRICAL SAFETY:

Physiological effects of electricity, Importance susceptibility parameters, Distribution of electric power, Macro shock hazards, Microshock hazards, Electrical - safety codes and standards, protection against shock; Protection - electrical safety analyzers, testing electric system, tests of electric appliances, problems.

PRACTICES:

- Predict the thermal effects of tissue by operation of Hyperthermia through simulation
- Predict the thermal effects of tissue by operation of High intensity focused ultrasound therapy simulation
- Electrical safety measurements
- Examine the Protection of electrical safety issue of instruments

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Classify critical equipment into various units	Analyze	1	1, 2, 4, 9, 10
2	Distinguish the different diathermy equipment by applying physics laws and Evaluate the diathermy units to estimate the treatment plans.	Analyze	1	1, 2, 5, 9, 10, 12
3	Design the components and working of drug delivery systems	Creative	1	1, 2, 3, 5, 9, 10, 12
4	Apply ultrasound physics to realize the treatment of kidney stones, cancer	Apply	2	1, 2, 4 9, 10, 12
5	Evaluate the electrical safely carrying out therapeutic devices in hospitals	Evaluate	2	1, 2, 4, 5 9, 10

TEXT BOOKS:

1. Khandpur R.S, “Handbook of Biomedical Instrumentation”, 3rd edition, Tata McGraw Hill, 2014.
2. Leslie Cromwell, “Biomedical Instrumentation and Measurement”, 4rd edition, Prentice Hall, 2015.

REFERENCE BOOKS:

1. John G. Webster, “Medical Instrumentation Application and Design”, 4th edition, John Willey and Sons, 2015.
2. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, 4th edition, Pearson Education, 2014.
3. L.A Geddas and L.E.Baker, “Principles of Applied Biomedical Instrumentation”, 3rd edition, 2017.
4. Myer Kutz “Standard Handbook of Biomedical Engineering and Design”, McGraw-Hill Publisher, 2013.

22BM854 MEDICAL IMAGING MODALITIES

https://openmedscience.com/medical-imaging/

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Engineering Physics, signals and systems, Biomedical Instrumentation.

COURSE DESCRIPTION AND OBJECTIVES:

This course studies the image reconstruction techniques, quality assurance test for radiography, method of recording sectional image, functioning of radioisotopic imaging equipment and the MRI, image acquisition and reconstruction, it also explains the 3-D image display techniques. This course aimed at imparting knowledge of operation and medical applications of the major medical imaging techniques.

MODULE - 1

UNIT-1 **6L+6T+0P=12 Hours**

INTRODUCTION:

X-ray, CT, Ultrasound, MRI, PET-CT, SPECT-CT, Gamma Camera, Catheterization Lab. Image perception, Image acquisition, Display, Image processing operations, scanning.

X-RAY: X-Ray imaging, Fundamentals of X-ray, Electromagnetic radiation, Interactions between X-rays and matter, Intensity of X-ray beam, Attenuation, Generation and detection of X-rays, biological effects of ionizing radiation; X-Ray diagnostic methods - conventional X-ray radiography, fluoroscopy, angiography, mammography and xeroradiography.

CT: Conventional tomography, Computed tomography - projection function, algorithms for image reconstruction, multiplanar reconstruction, non-spiral CT technology, concepts of spiral CT scanner, multi slice spiral technology, Recent applications – CT angio, cardiac CT, dual energy CT.

UNIT-2 **10L+10T+0P=20 Hours**

ULTRASOUND IMAGING:

Fundamentals of acoustic propagation - characteristic impedance, intensity, reflection and refraction, attenuation, Doppler effect; Generation and detection of Ultrasound - piezoelectric effect, ultrasonic transducers.

ULTRASONIC DIAGNOSTIC METHODS:

Pulse echo systems - amplitude mode (A-mode), brightness mode (B-mode), motion mode (M-mode), 3D, 4D, Doppler methods, duplex imaging, colour Doppler flow imaging, image artifact, biological effects of ultrasound.

PRACTICES:

- Analyse the radiation exposure to patients by using low kV values
- Evaluate the prevention of unnecessary exposure to patients in digital radiography
- Evaluate the rejection analysis in radiography reduce unnecessary exposure to patients
- Determines the Quality of the chemical processing of radiographic film have any effect on the radiation exposure of a patient
- Determines the radiation dose to the breast of patients in mammography
- Determines the radiation exposure to a patient affected by the size of the image (area covered by the X-ray beam)
- Apply the reconstruction techniques of the CT images for generation of image
- Analysis the radiation doses to patients undergoing cardiac CT procedures compare to doses from other radiographic procedures
- Design and Develop the ultrasound transducer
- Determines the ultrasound modes for examine the diseases

SKILLS:

- ✓ *Study the physics behind medical imaging.*
- ✓ *Determine the basis for an image is formation.*
- ✓ *Know the image formation in MRI.*
- ✓ *Grasp the knowledge of CT and importance of a medical department.*
- ✓ *Image acquisition and processing of images for required model.*
- ✓ *Integration of CT_PET for structural and functional analysis of disease.*
- ✓ *Calculate dose limits and differentiate between controlled areas and radiation hazards.*

MODULE-2

UNIT-1 **8L+8T+0P=16 Hours**

MAGNETIC RESONANCE IMAGING:

Basics of magnetic resonance imaging, Fundamentals of nuclear magnetic resonance - angular momentum, magnetic dipole moment, magnetization, larmour frequency, free induction decay (FID), Fourier spectrum of the NMR signal, spin density, relaxation times, pulse sequences.

MRI SYSTEM & IMAGING METHODS:

Introduction, Magnet, NMR Coil/Probe, Transmitter, Receiver, Data acquisition; Imaging methods - introduction, slice selection, frequency encoding, phase encoding, spin-echo imaging, gradient echo imaging; Characteristics of MRI images - spatial resolution, image contrast, biological effects of magnetic fields, static magnetic fields, radiofrequency fields, gradient magnetic fields, imaging safety, functional MRI (brief introduction only).

UNIT-2 **8L+8T+0P=16 Hours**

NUCLEAR IMAGING:

Physics of gamma camera, Basic instrumentation, Imaging techniques, SPECT and whole body studies; Applications of gamma camera in cardiology, Nephrology, Neurology etc., PET - fundamentals of PET scanner and PET- CT, crystal technology, cyclotron principle, Applications of PET - cardiology, neurology and cardiology.

PRACTICES:

- Analysis the MRI compare with doses from other examinations.
- Determine the reconstruction techniques of the MRI images for generation of image
- Analysis the PET/CT radiation doses compare with doses from other examinations.
- Determine the patient exposure PET/CT radiation given in an examination
- Determine the optimize image quality in a gamma camera examination
- Determine the optimization in diagnostic nuclear medicine

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyse the CT image reconstruction techniques using different algorithms.	Analyze	1	1, 2, 4, 5 9, 10, 12
2	Apply the concepts of ultrasound image formation model and analyse the biological effects.	Apply	1	1, 2, 5, 9, 10, 12
3	Apply MRI pulse sequences & hardware systems for tissues imaging and its hardware.	Apply	1	1, 2, 4, 5, 9, 10, 12
4	Analyse the nuclear spins and the decay systems of NMR.	Analyze	2	1, 2, 4, 5 9, 10, 12
5	Analyse the SPECT- PET imaging formation techniques in cardiology and neurology.	Analyze	2	1, 2, 4, 5, 9, 10, 12

TEXT BOOKS:

1. Kirk Shung, Michael B. Smith and Banjamin Tsui, “Principles of Medical Imaging”, Academic Press, 2015.
2. Paul Suetens, “Fundamentals of Medical Imaging”, 3rd edition, Cambridge University Press, 2017.

REFERENCE BOOKS:

1. Michael Chappell, “Principles of Medical Imaging for Engineers”, Springer, 2019.
2. Stewart C.Bushong, Geoffrey Clarke “Magnetic Resonance imaging –Physical and biological principles”, Elsvier, 4th edition, 2014.
3. Hykes, Heorick, Starchman, “Ultrasound physics and Instrumentation”, MOSBY, 6th edition, 2021.
4. Russell K Hobbie, Bradley J Roth, “Intermediate physics for medicine for biology, Springer, New York, 4th edition, 2013.

22BM855 BIOMATERIALS

https://www.mdpi.com/2076-3417/8/7/1037/htm

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Engineering Physics, Engineering Chemistry, Biochemistry.

COURSE DESCRIPTION AND OBJECTIVES:

This course aims at imparting the knowledge of material science, chemistry and characteristics and classification of biomaterials. It is useful to learn about different metals and ceramics used as biomaterials, polymeric materials and combinations for mechanism of tissue replacement implants and also gives knowledge of the artificial organ development.

MODULE–1

UNIT-1 **6L+0T+6P=12 Hours**

STRUCTURE OF BIO-MATERIALS AND BIO-COMPATIBILITY:

classification of biomaterials, Mechanical properties, Viscoelasticity, wound healing process, Body response to implants, Blood compatibility.

UNIT-2 **10L+0T+10P=20 Hours**

IMPLANT MATERIALS:

Metallic implant materials, Stainless steels, Co based alloys, Ti-based alloys, Ceramic implant materials, Aluminium oxides, Hydroxyapatite, Glass ceramics, Carbons, Medical applications.

PRACTICES:

- Biomaterial properties analysis
- Design an implants using the metals, metals alloys and polymers with simulation (COMSOL multi-physics)
- Analyze the Polymerization process and techniques suitable for different implants
- Implant materials analysis with respect to Size, Position, load and resection

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

POLYMERIC IMPLANT MATERIALS:

Polymerization, Polyamides, Acryrilic polymers, Biopolymers, Medical textiles silica, Chitosan, PLA composites, Sutures, Wound dressings; Materials for ophthalmology.

UNIT-2 **8L+0T+8P=16 Hours**

TISSUE REPLACEMENT IMPLANTS:

Soft tissue replacements, Maxillofacial augmentation, Vascular grafts, Hard tissue replacement Implants.

PRACTICES:

- Hard tissue replacement analysis.
- Bone remodeling analysis.
- Hip replacement model analysis.
- Design of Musculoskeletal structure

SKILLS:

- ✓ *Classification and investigation of suitable biomaterials*
- ✓ *Study various materials for biocompatibility.*
- ✓ *Analyzation of suitable biomaterials used for medical grafts*
- ✓ *Determine and selection of right materials for its bio applications.*
- ✓ *Apply specific design and quality control.*
- ✓ *Selection of the right materials for prostatics, implants or whole organs replacement with artificial organs.*

- Design of dental implants.
- Design simulation and fabrication of artificial bone.
- Design simulation and fabrication of prostatic heart valves.
- Design simulation and fabrication of sensing elements (Heating aids, Intraocular lens)

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Classify biomaterials based on biocompatibility and mechanical properties	Analyze	1	1, 2, 4, 5 9, 10, 12
2	Identify suitable metals/ polymers for fabrication of wound dressings and implant/prostatics design.	Analyze	1	1, 2, 4, 5, 9, 10, 12
3	Differentiate the implant materials based on metal composition for different tissues.	Analyze	1	1, 2, 4, 5, 9, 10, 12
4	Determine the materials that are compatible for soft tissue and hard tissue replacements	Analyze	2	1, 2, 4, 5 9, 10, 12
5	Evaluate the suitability of artificial materials properties for replacement of organ functions	Evaluate	2	1, 2, 4, 5, 9, 10

TEXT BOOKS:

1. Joseph D. Bronzino," The Biomedical Engineering Hand Book, 5th Edition Boca Raton: CRC Press LLC, 2015.
2. John D. Enderle, "Introduction to Biomedical Engineering",4th edition, Academic Press, 2022.

REFERENCE BOOKS:

1. Ernesto Iadanza, "Clinical Engineering handbook",2nd edition, Academic Press, 2020.
2. A.C Anand, J F Kennedy, M. Miraftab, S.Rajendran, "Medical Textiles and Biomaterials for Healthcare", 2nd edition, CRC, 2016.
3.. M.Lysaght, T.J. Webster, "Biomaterials and Artificial organs",1st edition, woodhead publishing, Cambrige,2013.
4. William R Wagner, "Biomaterials Science: An Introduction to Materials in Medicine", Academic Press, 2nd edition, Narosa Publishing House, 2020.

22BM956 ROBOTICS AND AUTOMATION IN MEDICINE

https://www.ul.com /news/safety-testing-healthcare-robotics

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Biosensors and Transducers.

COURSE DESCRIPTION AND OBJECTIVES:

To provide the basic knowledge on design, analysis, control and working principle of robotics in surgery, rehabilitation and drug delivery (Nano robot).

MODULE–1

UNIT-1 **9L+0T+6P=15 Hours**

INTRODUCTION OF ROBOTICS:

ntroduction to robotics and its history, Overview of robot sub systems, Degrees of freedom, Configurations and concept of workspace, Automation, Mechanisms and Movements, Dynamic stabilization - applications of robotics in medicine.

UNIT-2 **15L+0T+10P=25 Hours**

ACTUATORS AND GRIPPERS:

Pneumatic and hydraulic actuators, Stepper motor control circuits, End effectors, Various types of grippers, Design consideration in vacuum and other methods of gripping, PD and PID feedback actuator models

MANUPULATORS & BASIC KINEMATICS:

Construction of manipulators, Manipulator dynamic and force control, Electronic and pneumatic manipulator, Forward kinematic problems, Inverse kinematic problems, Solutions of inverse kinematic problems.

PRACTICES:

- Demonstration different types of medical robots and their potential applications
- Summarize the principles of sensors, actuators and grippers for robots
- Use the software tools for designing and analyzing the robot motion
- Create stepper motor control circuits
- Design consideration in vacuum and other methods of gripping
- Construction of manipulators and force control system
- Summarize kinematics, dynamics, and control relevant to medical robotics

MODULE-2

UNIT-1 **12L+0T+8P=20 Hours**

POWER SOURCES AND SENSORS:

Sensors and controllers, Internal and external sensors, Position, Velocity and acceleration sensors, Proximity sensors, Force sensors, Laser range finder, Variable speed arrangements, Path determination, Machinery vision, Ranging - laser acoustic, magnetic fiber optic and tactile sensor.

UNIT-2 **12L+0T+8P=20 Hours**

ROBOTICS IN MEDICINE:

Da vinci surgical system, Image robotic systems for focal ultrasound based surgical applications,

SKILLS:

- ✓ *Design and Implement Robotics*
- ✓ *Create a compelling proposal for a new medical robot technology*
- ✓ *Examine concepts in kinematics, dynamics, and control relevant to medical robotics*
- ✓ *Use the software tools for designing and analyzing the robot motion.*

System concept for robotic, Tele surgical system for off pump CABG surgery, Urologic applications, Cardiac surgery, Neuro surgery, Pediatric and general surgery, Gynecologic surgery, General surgery and Nano robotics.

PRACTICES:

- Classify the performance to various sensors to its environment
- Design simple robots for surgical applications
- Apply state of the art in medical robotics and its applications

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply concepts of robotic systems with configuration and mechanism in the medical field	Apply	1	1, 2, 5, 9, 10, 12
2	Apply the various concepts of manipulators, actuators and grippers for robot's system	Analyze	1	1, 2, 5, 9, 10, 12
3	Design basic robotics system and formulate Kinematic, Inverse Kinematic motion planning solutions for various Robotic configurations	Analyze	1	1, 2, 3, 5, 9, 10,1 2
4	Analyze various types of sensors and power sources useful in robotic system design	Analyze	2	1, 2, 4, 9,10, 12
5	Design and develop a Robotic system for Medical application.	Creative	2	1, 2, 3, 4, 9, 10, 12

TEXT BOOKS:

1. Andrew J. Kurdila, Pinhas Ben-Tzvi, "Dynamics and Control of Robotic Systems", John Wiley and Sons, 1st edition, 2019.
2. Saeed B. Niku, "Introduction to Robotics: Analysis, Control, Applications",3rd edition, WILEY, 2020.

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1. Jacob Rosen, Blake Hannaford & Richard M Satava, "Surgical Robotics: System Applications & Visions", Springer 2011.
2. Nagrath and Mittal, "Robotics and Control", Tata McGraw-Hill, 1st edition, 2017.
3. Constantinos Mavroidis, Antoine Ferreira, "Nanorobotics: Current approaches and Techniques", Springer 2013.