ANNAMALAI UNIVERSITY
DEPARTMENT OF ELECTRONICS & INSTRUMENTATION ENGINEERING

VISION

To nurture higher echelons of technology through participative education, innovative and collaborative research with a view to bring out employable graduates of International standard.

MISSION

- To establish sate of art facilities related to diverse dimension in the field of Instrumentation Engineering, Biomedical Engineering and Microelectronics and MEMS.
- To foster higher quality of education with equivocal focus in theory and practical areas of Electronics, Control and Instrumentation Engineering, Biomedical Engineering and Microelectronics and MEMS.
- To ensure that the dissemination of knowledge reaches the stakeholders and forge the opening of a fresh flair of human resources.
- To create opportunities for advancements in different facets of this discipline and offer avenues to reach the citadels of one's carrier.

M.E. (REHABILITATIVE INSTRUMENTATION)

PROGRAM EDUCATIONAL OBJECTIVES

The major objectives of the M.E (Rehabilitative Instrumentation) programme are to implement science and engineering principles in the broad area of medical instrumentation to improve healthcare delivery to human in association with physicians and surgeons.

1. Comprehend the fundamental concepts in Bio Medical Engineering
2. Apply knowledge of engineering, biology, and biomechanical principles to the design, development, and evaluation of various medical devices for cost effective diagnosis and treatment of various ailments.
3. To help the society and specifically the physically challenged person for their comfortable life style.

PROGRAM OUTCOMES

A student who has undergone the M.E (Rehabilitative Instrumentation) program would

1. Possess a good knowledge of basic science (including medicine), mathematics & engineering required for specific topics in Rehabilitation Engineering.
2. Have skill to use of different types of sensors and measurement of various physiological parameters
3. Possess ability to provide effective solutions through data interpretation, design & implementation (as applicable to a given topic/scenario).
4. Able to identify the latest tools (hardware &/or software/program &/or materials) available, towards an effective biomedical solution to a given problem.
5. Understand the current healthcare necessities & the associated multidisciplinary environment and sustainability, and an ability to provide appropriate engineering-solutions especially for Physically Challenged persons
6. Able to take leadership in investigating complex healthcare problems by putting together, a cohesive multidisciplinary team.
7. Able to understand about various imaging modalities used in the Hospitals
8. Learn some of the latest techniques that can be applied to research
9. Focuss the experience through Hospital training and projects in one or more areas of advanced research.

Mapping of PEO with PO									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
PEO1	✓	✓		✓		✓		✓	
PEO2	✓	✓			✓		✓		✓
PEO3	✓	✓	✓		✓	✓	✓	✓	

ANNAMALAI UNIVERSITY
FACULTY OF ENGINEERING AND TECHNOLOGY

M.E. / M. Tech (Two-Year Full Time& Three-year Part Time) DEGREE

PROGRAMME

CHOICE BASED CREDIT SYSTEM (CBCS)

REGULATIONS

1. **Condition for Admission**

   Candidates for admission to the first year of the four-semester **M.E / M.Tech Degree programme in Engineering** shall be required to have passed B.E / B.Techdegree of Annamalai University or any other authority accepted by the syndicate of this University as equivalent thereto. They shall satisfy the condition regarding qualifying marks and physical fitness as may be prescribed by the syndicate of the AnnamalaiUniversity from time to time. The admission for part time programme is restricted to those working or residing within a radius of **90 km** from Annamalainagar. The application should be sent through their employers.

2. **Branches of Study in M.E / M.Tech**

   The Branch and Eligibility criteria of programmes are given in **Annexure 1**

3. **Courses of study**

   The courses of study and the respective syllabi for each of the M.E / M. Tech programmes offered by the different Departments of study are given separately.

4. **Scheme of Examinations**

   The scheme of Examinations is given separately.

5. **Choice Based Credit System (CBCS)**

   The curriculum includes three components namely Professional Core, Professional Electives and Open Electives in addition toThesis. Each semester curriculum shall normally have a blend of theory and practical courses.

6. **Assignment of Credits for Courses**

   Each course is normally assigned one credit per hour of lecture / tutorial per week and one credit for two hours or part thereof for laboratory or practical per week.The total credits for the programme will be 65.

7. **Duration of the programme**

   A student of **M.E / M.Tech**programme is normally expected to complete in four semesters for full-time / six semesters for part-time but in any case not more than four years for full-time / six years for part-time from the date of admission.

8. **Registration for courses**

   A newly admitted student will automatically be registered for all the courses prescribed for the first semester, without any option. Every other student shall submit a completed registration form indicating the list of courses intended to be credited during the next semester. This registration will be done a week before the last working day of the current semester. Late registration with the approval of the Dean on the recommendation of the Head of the Department along with a late fee will be done up to the last working day. Registration for the Thesis Phase - I and II shall be done at the appropriate semesters.

9. Electives

The student has to select two electives in first semester and another two electives in the second semester from the list of Professional Electives. The student has to select two electives in third semester from the list of Open Electives offered by the department/ allied department. A student may be allowed to take up the open elective courses of third semester (Full Time program) in the first and second semester, one course in each of the semesters to enable them to carry out thesis in an industry during the entire second year of study provided they should register those courses in the first semester itself. Such students should meet the teachers offering those elective courses themselvesfor clarifications. No specific slots will be allotted in the time table for such courses.

Further, the two open elective courses to be studied in III semester (Full Time programme) may also be credited through the SWAYAM portal of UGC with the approval of Head of the Department concerned. In such a case, the courses must be credited before the end of III Semester.

10. Assessment

The break-up of continuous assessment and examination marks for theory courses is as follows:

First assessment (Mid-Semester Test-I)	:	10 marks
Second assessment (Mid-Semester Test-II)	:	10 marks
Third Assessment	:	5 marks
End Semester Examination	:	75 marks

The break-up of continuous assessment and examination marks for Practical courses is as follows:

First assessment (Test-I)	:	15 marks
Second assessment (Test-II)	:	15 marks
Maintenance of record book	:	10 marks
End Semester Examination	:	60 marks

The thesis Phase I will be assessed for 40 marks by a committee consisting of the Head of the Department, the guide and a minimum of two members nominated by the Head of the Department. The Head of the Department will be the chairman. The number of reviews must be a minimum of three per semester. 60 marks are allotted for the thesis work and viva voce examination at the end of the third semester. The same procedure will be adopted for thesis Phase II in the fourth semester.

11. Student Counsellors (Mentors)

To help the students in planning their course of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a member of the faculty who shall function as student counsellor for those students throughout their period of study. Such student counsellors shall advise the students, give preliminary approval for the courses to be taken by the students during each semester, monitor their progress in SWAYAM courses / open elective courses and obtain the final approval of the Head of the Department.

12. Class Committee

For each of the semesters of M.E / M.Techprogrammes, separate class committees will be constituted by the respective Head of the Departments. The composition of the class committees from first to fourth semesters for Full time and first to sixth semesters for Part-time will be as follows:

- Teachers of the individual courses.
- A Thesis coordinator (for Thesis Phase I and II) shall be appointed by the Head of the Department from among the Thesis supervisors.
- A thesis review committee chairman shall be appointed by the Head of the Department
- One Professor or Associate Professor, preferably not teaching the concerned class, appointed as Chairman by the Head of the Department.
- The Head of the Department may opt to be a member or the Chairman.
- All counselors of the class and the Head of the Department (if not already a member) or any staff member nominated by the Head of the Department may opt to be special invitees.

The class committee shall meet **three** times during the semester. The first meeting will be held within two weeks from the date of class commencement in which the type of assessment like test, assignment etc. for the third assessment and the dates of completion of the assessments will be decided.

The second meeting will be held within a week after the completion of the first assessment to review the performance and for follow-up action.

The third meeting will be held after all the assessments but before the University semester examinations are completed for all the courses, and at least one week before the commencement of the examinations. During this meeting the assessment on a maximum of 25 marks for theory / 40 marks for practical and project work will be finalized for every student and tabulated and submitted to the Head of the Department for approval and transmission to the Controller of Examinations.

13. Temporary Break Of Study

A student can take a one-time temporary break of study covering the current semester and / or the next semester with the approval of the Dean on the recommendation of the Head of the Department, not later than seven days after the completion of the mid-semester test. However, the student must complete the entire programme within the maximum period of **four years for Full time / six years for Part time.**

14. Substitute Assessments

A student who has missed, for genuine reasons accepted by the Head of the Department, one or more of the assessments of a course other than the end of semester examination may take a substitute assessment for any one of the missed assessments. The substitute assessment must be completed before the date of the third meeting of the respective class committees.

A student who wishes to have a substitute assessment for a missed assessment must apply to the Head of the Department within a week from the date of the missed assessment.

15. Attendance Requirements

The students with 75% attendance and above are permitted to appear for the University examinations. However, the Vice Chancellor may give a rebate / concession not exceeding 10% in attendance for exceptional cases only on Medical Grounds.

A student who withdraws from or does not meet the minimum attendance requirement in a semester must re-register and repeat the same semester in the subsequent academic years.

16. Passing anddeclaration of Examination Results

All assessments of all the courses on an absolute marks basis will be considered and passed by the respective results passing boards in accordance with the rules of the University. Thereafter, the controller of examinations shall convert the marks for each course to the corresponding letter grade as follows, compute the grade point average (GPA) and cumulative grade point average (CGPA) and prepare the mark sheets.

90 to 100 marks	Grade 'S'
80 to 89 marks	Grade 'A'
70 to 79 marks	Grade 'B'
60 to 69 marks	Grade 'C'
55 to 59 marks	Grade 'D'
50 to 54 marks	Grade 'E'
Less than 50 marks	Grade 'RA'
Withdrawn from the Examination	Grade 'W'

A student who obtains less than 30 / 24 marks out of 75 / 60 in the theory / practical examinations respectively or is absent for the examination will be awarded grade RA.

A student who earns a grade of S, A, B, C, D or E for a course is declared to have successfully completed that course and earned the credits for that course. Such a course cannot be repeated by the student.\

A student who obtains letter grade RA / W in the mark sheet must reappear for the examination of the courses.

The following grade points are associated with each letter grade for calculating the grade point average and cumulative grade point average.

S - 10; A - 9; B - 8; C - 7; D - 6; E - 5; RA - 0

Courses with grade RA / W are not considered for calculation of grade point average or cumulative grade point average.

A student can apply for re-totaling of one or more of his examination answer papers within a week from the date of issue of mark sheet to the student on payment of the prescribed fee per paper. The application must be made to the Controller of Examinations with the recommendation of the Head of the Department.

After the results are declared, mark sheets will be issued to the students. The mark sheet will contain the list of courses registered during the semester, the grades scored and the grade point average for the semester.

GPA is the sum of the products of the number of credits of a course with the grade point scored in that course, taken over all the courses for the semester, divided by the sum of the number of credits for all courses taken in that semester.

CGPA is similarly calculated considering all the courses taken from the time of admission.

17. Awarding Degree

After successful completion of the programme, the degree will be awarded with the following classifications based on CGPA.

For First Class with Distinction the student must earn a minimum of 65 credits within four semesters for full-time / six semesters for Part time from the time of admission, pass all the courses in the first attempt and obtain a CGPA of 8.25 or above.

For First Class, the student must earn a minimum of 65 credits within two years and six months for full-time / three years and six months for Part time from the time of admission and obtain a CGPA of 6.75 or above.

For Second class, the student must earn a minimum of 65 credits within four years for full-time / six years for Part time from the time of admission.

18. Ranking Of Candidates

The candidates who are eligible to get the M.E /M.Techdegree in First Class with Distinction will be ranked on the basis of CGPA for all the courses of study from I to IV semester for M.E / M.Tech full-time / I to VI semester for M.E / M.Tech part-time.

The candidates passing with First Class and without failing in any subject from the time of admission will be ranked next to those with distinction on the basis of CGPA for all the courses of study from I to IV semester for full-time / I to VI semester for M.E / M.Tech part-time.

19. Transitory Regulations

If a candidate studying under the old regulations M.E. / M.Tech could not attend any of the courses in his/her courses, shall be permitted to attend equal number of courses, under the new regulation and will be examined on those subjects. The choice of courses will be decided by the concerned Head of the department. However he/she will be permitted to submit the thesis as per the old regulations. The results of such candidates will be passed as per old regulations.

The University shall have powers to revise or change or amend the regulations, the scheme of examinations, the courses of study and the syllabi from time to time.

ANNEXURE 1

S.No.	Department		Programme (Full Time & Part time)	Eligible B.E./B.TechProgramme *
1	**Civil Engineering**	i.	Environmental Engineering	B.E. / B.Tech – Civil Engg, Civil & Structural Engg, Environmental Engg, Mechanical Engg, Industrial Engg, Chemical Engg, BioChemicalEngg, Biotechnology, Industrial Biotechnology, Chemical and Environmental Engg.
		ii.	Environmental Engineering & Management	
		iii.	Water Resources Engineering & Management	B.E. / B.Tech – Civil Engg, Civil & Structural Engg, Environmental Engg, Mechanical Engg, Agricutural and irrigation Engg, Geo informatics, Energy and Environmental Engg.
2	**Civil & Structural Engineering**	i.	Structural Engineering	B.E. / B.Tech – Civil Engg, Civil & Structural Engg.
		ii.	Construction Engg. and Management	
		iii.	Geotechnical Engineering	
		iv.	Disaster Management &Engg.	
3	**Mechanical Engineering**	i.	Thermal Power	B.E. / B.Tech – Mechanical Engg, Automobile Engg, Mechanical Engg (Manufacturing).
		ii.	Energy Engineering & Management	B.E. / B.Tech – Mechanical Engg, Automobile Engg, Mechanical (Manufacturing) Engg, Chemical Engg
4	**Manufacturing Engineering**	i.	Manufacturing Engineering	B.E. / B.Tech – Mechanical Engg, Automobile Engg, Manufacturing Engg, Production Engg, Marine Materials science Engg, Metallurgy Engg, Mechatronics Engg and Industrial Engg.
		ii.	Welding Engineering	
		iii.	Nano Materials and Surface Engineering	B.E. / B.Tech – Mechanical Engg, Automobile Engg, Manufacturing Engg, Production Engg, Marine Materials science Engg, Metallurgy Engg, Chemical Engg
5	**Electrical Engineering**	i.	Embedded Systems	B.E. / B.Tech – Electrical and Electronics Engg, Control and Instrumentation Engg, Information technology, Electronics and communication Engg, Computer Science and Engg

		ii.	Smart Energy Systems	B.E. / B.Tech – Electrical and Electronics Engg, Control and Instrumentation Engg, Electronics and communication Engg,
		iii.	Power System	
6	**Electronics & Instrumentation Engineering**	i.	Process Control & Instrumentation	B.E. / B.Tech – Electronics and Instrumentation Engg, Electrical and ElectornicsEngg, Control and Instrumentation Engg, Instrumentation Engg
		ii.	Rehabilitative Instrumentation	B.E. / B.Tech – Electronics and Instrumentation Engg, Electrical and ElectornicsEngg, Electronics and communication Engg, Control and Instrumentation Engg, Instrumentation Engg, Bio Medical Engg, Mechatronics.
		iii.	Micro Electronics and MEMS	B.E. / B.Tech – B.E. / B.Tech – Electronics and Instrumentation Engg, Electrical and ElectornicsEngg, Electronics and communication Engg, Control and Instrumentation Engg, Instrumentation Engg, Bio Medical Engg, Mechatronics, Telecommunication Engg
7	**Chemical Engineering**	i.	Chemical Engineering	B.E. / B.Tech – Chemical Engg, Petroleum Engg, Petrochemical Technology
		ii.	Food Processing Technology	B.E. / B.Tech - Chemical Engg, Food Technology, Biotechnology, Biochemical Engg, Agricultural Engg.
		iii.	Industrial Bio Technology	B.E. / B.Tech - Chemical Engg, Food Technology, Biotechnology, Leather Technology
		iv.	Industrial Safety Engineering	B.E. / B.Tech – Any Branch of Engineering
8	**Computer Science & Engineering**	i.	Computer Science & Engineering	B.E. / B.Tech - Computer Science and Engineering, Information Technology, Electronics and Communication Engg, Software Engineering
9	**Information Technology**	I	Information Technology	B.E. / B.Tech - Computer Science and Engineering, Information Technology, Electronics and Communication Engg, Software Engineering
10	**Electronics & Communication Engineering**	i.	Communication Systems	B.E. / B.Tech -Electronics and Communication Engg, Electronics Engg.

*** AMIE in the relevant discipline is considered equivalent to B.E**

DEPARTMENT OF ELECTRONICS and INSTRUMENTATION ENGINEERING

Curriculum for M.E.(Rehabilitative Instrumentation)

Full-Time

Sl. No.	Category	Course Code	Course	L	P	T	FE	CA	Total	Credits
S e m e s t e r – I										
1	RI-I	RHIC 101	Applied Mathematics	4		-	25	75	100	3
2	RI-II	RHIC 102	Medical Physiology	4		-	25	75	100	3
3	RI-III	RHIC 103	Biosensors and Transducers	4		-	25	75	100	3
4	RI-IV	RHIC 104	Impairment Engineering	4		-	25	75	100	3
5	PE-I	RHIE 105	Professional Elective – I	4		-	25	75	100	3
6	PE-II	RHIE 106	Professional Elective – II	4		-	25	75	100	3
7	RI Lab-I	RHIP 107	Biosignal and Image Processing Lab	-	3	-	40	60	100	2
			Total	**24**	**3**	**-**	**190**	**510**	**700**	**20**

Sl. No.	Category	Course Code	Course	L	P	T	FE	CA	Total	Credits
S e m e s t e r – II										
1	RI-V	RHIC 201	Biomedical Instrumentation	4	-	-	25	75	100	3
2	RI-VI	RHIC 202	Modelling and Control of Biological Systems	4	-	-	25	75	100	3
3	RI-VII	RHIC 203	Biomechanics	4	-	-	25	75	100	3
4	RI-VIII	RHIC 204	Artificial Organ Systems	4	-	-	25	75	100	3
5	PE-III	RHIE 205	Professional Elective – III	4	-	-	25	75	100	3
6	PE-IV	RHIE 206	Professional Elective – IV	4	-	-	25	75	100	3
7	RI Lab-II	RHIP 207	Biomedical Instrumentation Lab	-	3	-	40	60	100	2
8	Semin	RHIS 208	Seminar	-	-	2	100	-	100	1
			Total	**24**	**5**	**-**	**290**	**510**	**800**	**21**

Sl. No.	Category	Course Code	Course	L	P	T	CA	FE	Total	Credits
S e m e s t e r – III										
1	OE-I	RHIE 301	Open Elective – I	4	-	-	25	75	100	3
2	OE-II	RHIE 302	Open Elective – II	4	-	-	25	75	100	3
3	Thesis	RHIT 303	Thesis Phase-I	-	-	4	40	60	100	4
4	IndTrain	PCII 304	Industrial Training		*	-	100	-	100	2
			Total	**8**	**4**	**-**	**190**	**210**	**400**	**12**

Note: * - Four weeks during the summer vacation at the end of IInd Semester.

Sl. No.	Category	Course Code	Course	L	P	T	CA	FE	Total	Credits
S e m e s t e r – IV										
1	Thesis	RHIT 401	Thesis Phase-II	-	-	8	60	40	100	13
			Total	**-**	**-**	**8**	**40**	**60**	**100**	**13**

L-Lecture ;**P-**Practical; **T-**Thesis; **CA-**Continuous Assessment; **FE-**Final Examination

DEPARTMENT OF ELECTRONICS and INSTRUMENTATION ENGINEERING

Curriculum for M.E.(Rehabilitative Instrumentation)

Part Time

Sl. No.	Category	Course Code	Course	L	P	T	FE	CA	Total	Credits	Equivalent Course Code in M.E. Full Time
S e m e s t e r – I											
1	RI-I	PRHIC 101	Applied Mathematics	4	-	-	25	75	100	3	RHIC 101
2	RI-II	PRHIC 102	Medical Physiology	4	-	-	25	75	100	3	RHIC 102
3	RI-III	PRHIC 103	Biosensors and Transducers	4	-	-	25	75	100	3	RHIC 103
			Total	**12**	**-**	**-**	**75**	**225**	**300**	**9**	

Sl. No.	Category	Course Code	Course	L	P	T	FE	CA	Total	Credits	Equivalent Course Code in M.E. Full Time
S e m e s t e r – II											
1	RI-IV	PRHIC 201	Biomedical Instrumentation	4	-	-	25	75	100	3	RHIC 201
2	RI-V	PRHIC 202	Modelling and Control of Biological Systems	4	-	-	25	75	100	3	RHIC 202
3	RI-VI	PRHIC 203	Biomechanics	4	-	-	25	75	100	3	RHIC 203
			Total	**12**	**-**	**-**	**75**	**225**	**300**	**9**	

Sl. No.	Category	Course Code	Course	L	P	T	FE	CA	Total	Credits	Equivalent Course Code in M.E. Full Time
S e m e s t e r – III											
1	RI-VII	PRHIC 301	Impairment Engineering	4	-	-	25	75	100	3	RHIC 104
2	PE-I	PRHIE 302	Professional Elective – I	4	-	-	25	75	100	3	RHIE 105
3	PE-II	PRHIE 303	Professional Elective – II	4	-	-	25	75	100	3	RHIE 106
4	PC Lab-I	PRHIP 304	Biosignal and Image Processing Lab	-	3	-	40	60	100	2	RHIP 107
			Total	**12**	**3**	**-**	**115**	**285**	**400**	**11**	

S.No	Category	Course Code	Course	L	P	T	FE	CA	Total	Credits	Equivalent Course Code in M.E. Full Time
S e m e s t e r – IV											
1	RI-VIII	PRHIC 401	Artificial Organ Systems	4	-	-	25	75	100	3	RHIC 204
2	PE-III	PRHIE 402	Professional Elective – III	4	-	-	25	75	100	3	RHIE 205
3	PE-IV	PRHIE 403	Professional Elective – IV	4	-	-	25	75	100	3	RHIE 206
4	PC Lab-II	PRHIP 404	Biomedical Instrumentation Lab	-	3	-	40	60	100	2	RHIP 207
5	Semin	PRHIS 405	Seminar		2		100		100	1	RHIS208
			Total	**12**	**5**	**-**	**215**	**285**	**500**	**12**	

Sl. No.	Category	Course Code	Course	L	P	T	CA	FE	Total	Credits	Equivalent Course Code in M.E. Full Time
S e m e s t e r – V											
1	OE-I	PRHIE 501	Open Elective – I	4	-	-	25	75	100	3	RHIE 301
2	OE-II	PRHIE 502	Open Elective – II	4	-	-	25	75	100	3	RHIE 302
3	Thesis	PRHIT 503	Thesis Phase-I	-	-	4	40	60	100	4	RHIT 303
4	Indus Train	PRHII 504	Industrial Training	*	-	100		100	2	2	RHII304
			Total	**8**	**4**	**-**	**190**	**210**	**400**	**12**	

Note: * - Four weeks during the summer vacation at the end of IVth Semester.

Sl. No.	Category	Course Code	Course	L	T	P	CA	FE	Total	Credits	Equivalent Course Code in M.E. Full Time
S e m e s t e r – VI											
1	Thesis	PRHIT 601	Thesis Phase-II	-	-	8	40	60	100	13	RHIT 401
			Total	**-**	**-**	**8**	**40**	**60**	**100**	**13**	

L-Lecture ;**P-**Practical; **T-**Thesis; **CA-**Continuous Assessment; **FE-**Final Examination

LIST OFPROFESSIONAL ELECTIVES

S.No	Subject
1	Medical Image Processing
2	Medical Diagnostic Instrumentation
3	Computational Neuroengineering
4	Computational Methods and Cancer Modelling
5	Biosignal Processing
6	Transportation in Living Systems
7	Cancer Biology
8	Computational Methods and Bone Modelling
9	Medical Imaging System and Radio Therapy
10	Wavelet Transforms and its applications
11	Bioinformatics
12	Medical Ethics and Standards

LIST OF OPEN ELECTIVES

S.No	Open Elective
1	Computers in Medicine
2	Tissue and Stem Cell Engineering
3	Hospital Engineering
4	Telemedicine
5.	Vision Impairment and Therapy
6.	Hearing Impairment and Therapy
7.	Audiology and Speech Therapy
8.	Soft Computing Techniques
9.	Bio MEMS and Nanotechnology
10.	Mediembedded Systems and RTOs
11.	Modelling of Physiological Systems
12.	Nano medicine Principles and Application

RHIC 101/ PRHIC 101	APPLIED MATHEMATICS	L	T	P
		4	0	0

COURSE OBJECTIVES

1. To enable the student to build up their mathematical ability and acquire the knowledge to understand the concepts with a sense of applicability
2. To encourage students to develop a working knowledge of the central ideas of Finite Analysis
3. To formulate and construct a mathematical model using Finite element models in real life situation;

Numerical Solution of Partial Differential Equations: Elliptic equation – Poison's equation and Laplace equation – Liebmann iterative method. Hyperbolic equation: one-dimensional wave equation and radio equation. Parabolic equation: one-dimensional heat equation and telegraph equation – Bender - Schmidt method – Crank Nicolson method.

Introduction to Finite Element Method for solving field problems:Stress and Equilibrium-Boundary conditions - Strain Displacement relations - Stress-strain relations.

One Dimensional problems: Finite element modelling - coordinates and shape functions. Potential Energy approach: Assembly of Global stiffness matrix and load vector - Finite element equations - Treatment of boundary conditions -quadrate shape functions.

Introduction to two dimensional modelling using Finite element method.Two dimensional problems with constant strain triangles and treatment of boundary conditions. Finite element modelling of Axisymmetrix solids subjected to Axisymmetrix loading with triangular elements.

Wavelets: Introduction- Continuous wavelet transform – wavelet time – frequency characteristics - Discrete wavelet transform - wavelet decomposition– reconstruction – denoising – medical applications

REFERENCES:

1. M.K. Venkataraman, Numerical Methods in Science and Engineering, National Publishing Company, 1986.
2. T.R. Chandrupatla and A.D. Belegundu, Introduction to Finite Elements in Engineering, Prentice Hall, 2003
3. Ronald.L. Allen, Duncan W. mills, Signal analysis Time, Frequency, Scale and Structure A.John Wiley&Sons, Inc., Publication, 2004

COURSE OUTCOME:

On successful completion of this course, all students should

1. Develope knowledge and understanding in the fields of Finite Element
2. Understand wavelet theory and solving real time signal analysis.
3. Understand the finite element based model development
4. Know use of PDEs for solving dynamic problems

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓							✓
CO3	✓	✓	✓		✓			✓	
CO4	✓	✓		✓					

RHIC 102/ PRHIC102	**MEDICAL PHYSIOLOGY**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

1. To understand basics of Human Anatomy and Physiology.
2. To understand different physiological processes taking place inside human body..
3. To impart knowledge on cell divisions, blood vascular system, ductless/endocrine glands, digestive system and nervous system and familiarize medical physiology to the students.
4. To apply this knowledge into biomedical engineering field.

Cell divisions and development of human body: Cell structure-functions. Tissues: Types of tissues, epithelial & connective, muscle and nervous. Classification of epithelial and connective tissues with their locations. Muscular architecture: Structure of skeletal, smooth and cardiac muscles -differences. Single unit and multi-unit smooth muscle -properties of muscle - muscle contraction sterling laws – mechanisms - E C coupling -muscle fatigue - rigor mortis - sliding filament theory -slow and fast muscle fibres -isotonic and isometric contraction.

Blood Vascular System:Composition and functions of blood, coagulation -actionof platelets, functions, mechanisms. Hemoglobin: functions - compounds and derivatives. Erythrocyte Sedimentation Rate (ESR) - significance. Blood coagulation – factors – process – anticoagulants - prothrombin time - clotting time - bleeding time - blood groups – ABO systems and Rh factors - Ultra structure and functions of blood vessels (artery and vein).

Ductless/endocrine glands: various ductless glands: pituitary glands – hypothalamus and adenohypohysis. Hormone secretion – actions of hormone and related applied physiology – thyroid gland – histology - blood and hormone secretion – action of hormone- Parathyroid gland and adrenal gland.

Digestive System: Anatomy – histology of gastro intestinal tract –oral cavity (mouth)- teeth-salivary glands - structure, composition and functions of saliva. Circulatory system: Anatomy - functions – heart valves – heart rhythm – conducting system of heart – blood supply - properties of cardiac muscles – action potential of single cardiac fiber - special junctionaltissue of heart -myogenic and neurogenic heart-conducting system of heart -E.C.G.

Nervous system: Anatomy - classification – structure of a typical neuron -synapse – synaptic transmission, neuro transmitter, Central Nervous System (CNS) – anatomy of brain and its sub divisions. Functions of brain–central canal of the spinal cord – thalamus and hypothalamus - spinal cord and transverse section effects. Peripheral nervous system – classifications of motor nerves – description- voluntary and involuntary action- Autonomic nervous system - classifications – functions. Neural Transmission: Introduction - sympathetic and parasympathetic response.CNS synaptic, electrical and chemical transmissions.Neuro muscular Junction: Structure- events in transmission- end-plate potential- post tetanic potential.

REFERENCES:

1. Arthur C.Guyton and John E. Hall, Text book of Medical Physiology, Saunders (Elsevier), NJ, 11th Edition, 2005.
2. B.G.King, W.J.Showers, Human Anatomy & Physiology, W.B.Saunders Co., NY,6th edition, 1969.
3. Ross and Wilson,Anatomy and Physiology in health and illness,Churchill Living Stone,11th edition,2010.

COURSE OUTCOMES:

By successfully completing this course, students will be able to:

1. Describe and explain specific parts and key terms applied in anatomy and physiology
2. Describe important physiological mechanisms involved in cell, tissue, and organ
3. Understand organisation and functions of each organs and systems in human body
4. Correlate the knowledge of medicine and engineering for the development of various instruments.

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓						✓	
CO2	✓	✓				✓			
CO3	✓	✓	✓		✓				
CO4	✓	✓		✓		✓			✓

RHIC 103/ PTRHIC 103	BIOSENSORS AND TRANSDUCERS	L	T	P
		4	0	0

COURSE OBJECTIVES

1. To provide a thorough understanding of principle and working of transducers and biopotential electrodes, chemical sensors, biosensors, fiber optic sensors, and radiation sensors.
2. To study the biomedical applications of the above transducers and sensors.
3. To study the techniques used for measurement of various non electrical physiological parameters.

The transducer and transduction principles: active transducers- passive transducers- sensor error sources- transducers for biomedical applications. Principles of transduction and measurement: Sensor Classification - Medically significant measurands– strain – force – pressure – acceleration – flow – volume - temperature and biopotentials. Functional specifications of medical sensors: static and dynamic characteristics of measurement systems.

Sensors: Resistives, capacitive, inductive types -reactance type – electromagnetic type. Signal conditioning: Wheatstone bridge - AC bridges. Amplifiers: AC - instrumentation - isolation – carrier - electrostatic shields - phase-sensitive detectors - interference types and reduction - shield grounding.

.

Recording Electrodes: Electrode-tissue interface – polarization - skin contact impedance - motion artifacts - Electrodes for ECG, EEG and EMG -electrical conductivity of electrode jellies and creams.

Biosensor: Sensors/receptors in the human body -ion exchange membrane electrodes - enzyme electrode -Glucose and immune sensors. Optical sensor: Photo detectors - optical fibre sensors - indicator mediated transducers - general principles of optical sensing - optical fibre temperature sensors. Pulse sensor: photoelectric pulse transducer - strain gauge pulse transducer.

Optical biosensor: indicator labelled bioassay - solid phase absorption label sensors - immunological sensors. Chemoreceptors: Hot and cold receptors – baroreceptors - sensors for smell, sound, vision, osmolality and taste.Transducers for the measurement of ions and dissolved gases:Ion exchange membrane electrodes - measurement of pH - glass pH electrodes -measurement of pO_2- measurement of pCO_2- ISFET for glucose and urea.

REFERENCES:

1. John G. Webster, Medical Instrumentation-Application and Design, John Wiley and Sons Inc., 3rd revised Ed., 2009.
2. L. A. Geddes and L. E. Baker, Principles of Applied Biomedical Instrumentation, John Wiley Publications, 3rd Edition,2008.
3. Brain R.Eggins, Biosensors: An Introduction, John Wiley Publication, 1997
4. Khandpur. R.S., Hand Book of Biomedical Instrumentation, Tata McGraw Hill Pub Co. Ltd., New Delhi,2nd ed., 2003.
5. D. L. Wise,Applied Bio Sensors, Butterworth Publishers, London 1989.

COURSE OUTCOMES:

After completion of the above course the students shall be competent in the following ways:

1) They have a clear understanding of generalized medical instrumentation system, general properties of input transducers, static and dynamic characteristics of transducers and sensors.

2) They have a thorough understanding of various transducers and sensors taught in the course.

3) They are able to apply the transducers and sensors learnt in the course in suitable medical contexts.

4) They have a working knowledge of some of the transducers and sensors that they have learnt in the course.

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓					✓		
CO3	✓	✓	✓		✓				
CO4	✓	✓		✓					

RHIC 104/ PTRHIC 104	**IMPAIRMENT ENGINEERING**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

1. To impart knowledge on impairment, sensory and auditory rehabilitation, orthopaedic prosthetics and orthotics in rehabilitation.
2. To study basics of Rehabilitation Engineering
3. To study various orthotic & prosthetic devices
4. To understand various assistive technology for vision & hearing

Impairment: Introduction – impairment types - handicaps –measurements – assessment and characterization concepts in sensory and motor rehabilitation. Anthropometry: Static and dynamic Measurements - Area - movement, measurement of Muscular Strength and Capabilities.

Measurement tools and processes: Fundamental principles – structure – functioning - performance and behaviour – Subjective and objective. Ergonomic aspects in designating devices: Design of information devices - traditional Devices -V.D.Uâ€™ s, Using colour and Control designs

Sensory and Auditory rehabilitation: 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 and substitution.

Orthopedic Prosthetics and Orthotics in rehabilitation: Motor rehabilitation: Introduction – concepts - applications. Intelligent prosthetic knee -hierarchically controlled prosthetic hand-self-aligning orthotic knee joint. Externally powered and controlled Orthotics and Prosthetics: FES systems-restoration of hand function, standing and walking- Hybrid Assistive Systems (HAS). Active Prostheses:Active above knee prostheses -myoelectric hand andarm prostheses - different types.The MARCUS intelligent Hand prostheses.

Computer applications in Rehabilitation and Robotic Manipulation Aids: Modes of operation and control - interfaces in compensation for visual perception -improvement of orientation and mobility. Computer assisted lipreading - Brain computer interface - concepts.

REFERENCES:

1. Joseph D. Bronzino,Handbook of biomedical engineering,CRC Press,3rd edition, 2006
2. Robinson C.J, Rehabilitation engineering. CRC press,2003.
3. Horia-Nicolai L Teodorescu, L.C.Jain, Intelligent systems and technologies in rehabilitation engineering; CRC Press; December 2000.
4. Etienne Grandjean, Harold Oldroyd, Fitting the task to the man, London:Taylor & Francis,4th edition, 1988.

COURSE OUTCOMES:

By the end of this course the student will be able

1. To design rehabilitation aid and apply themwith confidence, to help the challenged people.
2. to build foundation for learners enabling the learners to pursue higher studies with specialization in Rehabilitation Engineering
3. To design rehabilitation aids and its understanding
4. To have a thorough understanding of aids which can be useful with the societal needs.

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓							✓
CO3	✓	✓	✓		✓				
CO4	✓	✓		✓					

RHIP-107/PTRHIP-304	**BIOSIGNAL AND IMAGE PROCESSING LAB**	**L**	**T**	**P**
		0	**0**	**3**

LIST OF EXPERIMENTS **

1. Representation of basic signals
2. Linear convolution
3. Autocorrelation and cross correlation

4. Development of FFT and IFFT Techniques
5. Difference equation Representation of systems using Matlab
6. Digital IIR Butterworth filter-LPF & HPF
7. Digital IIR chebychev filter-LPF & HPF
8. Design of FIR filter using windowing technique
9. Upsampling and downsampling of Biosignals
10. Analysis of ECG
11. Analysis of EEG
12. Analysis of PCG

****The list of Experiments will be finalized by the course teacher in consultation with the HOD depending on the availability of equipments, the state of art and recent trends.**

RHIC 201/ PTRHIC 201	BIOMEDICAL INSTRUMENTATION	L	T	P
		4	0	0

COURSE OBJECTIVES

1. To understand the characteristics of bio-amplifiers and different types of recorders.
2. To understand how to measure various physiological parameters and helps to design simple biomedical sensors
3. To study the instrumentation concerned with measuring various parameters and the principle of working and gain knowledge on usage of instruments in hospitals and servicing.

Basic medical instrumentation system: Block diagram – design and performance requirements – constraints in design – types of biomedical equipments – analytical, diagnostic, therapeutic, surgi.cal – manual, microprocessor and PC based equipments – regulation of medical devices and testing of biomedical equipments.

Electrocardiography: ECG machine –recording of ECG -artifacts in ECG recording - types of ECG machines – vectorcardiograph – phonocardiograph – patient monitoring systems – bedside monitoring –cardiotocograph – methods of monitoring fetal heart rate - Holter monitoring and recording – cardiac stress testing – bicycle and treadmill tests.

Electroencephalograph: Block diagram – amplifiers, filters – sensitivity control – applications of EEG.Evoked potential measurement system – types and stimulations – analysis and storage of VEP, AEP and Somatosensory EP – brain mappers

Clinical applications of electrotherapy :Diathermy – measuring devices. Impedance Techniques : Bipolar and tetrapolar circuits - detection of physiological activities -impedance plethysmography- resistance and capacitance type -pulmonary function measurements and analysers–respiratory parameters – Spirometry – basic system – types and applications. Oximeters:Types – pulse oximeter- audiometers – pure tone and speech audiometers. Blood cell counters. Blood flowmeters: Electromagnetic– ultrasonic– NMR and Laser Doppler blood flowmeters.

Ultrasound Instrumentation: Doppler - Magnetic Resonance Imaging (MRI) - principles – pulse sequence- image acquisition and reconstruction techniques – MRI instrumentation – Functional MRI - Application of MRI. X-Ray Fluoroscopy – Computed tomography – Principles of sectional imaging – scanner configuration - data acquisition system.

REFERENCES:

1. R. S. Khandpur, Biomedical Instrumentation Technology and Applications, McGraw-Hill Professional, 2004.
2. Raja Rao. C; Guha. S.K, Principles of Medical Electronics and Biomedical Instrumentation, Orient Longman Publishers, 2001.
3. R.Anandanatarajan, Biomedical Instrumentation, PHI Learning, 2011
4. L. A. Geddes and L. E. Baker, Principles of Applied Biomedical Instrumentation, John Wiley Publications, 3rd Edition, 2008.
5. Khandpur. R. S., Handbook of Bio-Medical Instrumentation, Tata McGraw Hill, 2nd edition, 2003
6. Richard Aston, Principles of Biomedical Instrumentation and Measurements, Merril Publishing Co., 1990.

COURSE OUTCOME

Students will be able to

1. Demonstrate the principles of electronics used in designing various diagnostic equipment.
2. Have in-depth knowledge about different streams in Biomedical Engineering with greater emphasis on health care equipments and the advanced technologies such as Telemedicine, Telemetry, Medical Imaging, etc.
3. Exhibit competency in suggesting, designing and offering the apt, reliable and optimum solution after understanding customer's requirement completely.
4. Demonstrate ability of correlating theoretical concepts with their practical implementation while performing laboratory exercises and project work.

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓						✓	
CO2	✓	✓					✓		
CO3	✓	✓	✓		✓				✓
CO4	✓	✓		✓		✓		✓	✓

RHIC 202/ PTRHIC 202	MODELLING AND CONTROL OF BIOLOGICAL SYSTEMS	L	T	P
		4	0	0

COURSE OBJECTIVES

1. To gain basic knowledge about the concepts of control systems and study its application in physiological modeling.
2. To understand the system concepts and different mathematical modelling techniques applied in analyzing any given system.
3. To understand basic concepts of modeling for designing biological model.
4. To train and motivate students for pursuing higher education and research for developing cutting edge technologies.

Feedback system: Basic feedback concepts - effect of feedback on noise -distortion analysis - open loop control system-control system with feed Back. Mathematical descriptions of systems: transfer function matrix - state space representation - state-variable description - mathematical description of composite systems. Solution of dynamical equation: state transition matrix - impulse response matrix - controllability and observability.

Biological control system: Introduction - dynamical systems– modelling– similarities between biological and engineering control system - biological receptors and receptor characteristics.The pupil control systems:General structure – dynamic response characteristics– open and closed loop instability – automatic aperture control.

Human thermal system: Basic concepts - modelling– thermo regulation - cold and warm bloodedness – lumped and partial differential equations. Case Study: Heat transfer example. Modeling the body as compartment: behavior in simple compartmental system – pharmaco kinetic model – urea distribution model. Multi compartmental system: Dissolution of drugs in solid form – distribution and accessibility of body water and tissue compartments – basis for zero and first order chemical kinetic behavior in the biological system.

Modeling of human thermal regulatory system: Parameters involved - control system model - biochemistry of digestion - types of heat loss from body - heat transfer models - subsystems of human body like skin, core.

Case Study Applications: Cardiac rate - blood pressure - respiratory rate - mass balancing of lungs - oxygen uptake by RBC and pulmonary capillaries - oxygen and carbon dioxide transport in blood and tissues.

REFERENCES:

1. Benjamin C. Kuo, FaridGolnaraghi, Automatic Control Systems, John Wiley & Sons, Inc., NY, 9th edition, 2009.
2. M.Gopal, Digital Control and State Variable Analysis, Tata McGraw Hill, 2008.
3. David O. Cooney,Biomedical Engineering Principles - An introduction to Fluid, Heat, andMass transport processes, CRC Press, 1976.
4. John H Milsum, Biological Control Systems, McGraw Hill, 1966.
5. Howard T Milhorn, The application of control theory to physiological systems, Saunders, Philadelphia, 1966.

6. E. Carson, E. Salzsieder, Modelling and Control in Biomedical Systems 2000 (including Biological Systems) (IFAC Proceedings Volumes) (Paperback), Pergamon Publishing, January 2001.

COURSE OUTCOME

Students will be able to

1. Understand the concepts of modelling
2. Design control strategies for various organ functioning
3. Analyse the causes for malfunctioning of organs
4. Analyse and do research in the micro level for diagnosing the diseases

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓							
CO3	✓	✓	✓		✓				
CO4	✓	✓		✓					

RHIC 203/ PTRHIC 203	**BIOMECHANICS**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

1. To provide the knowledge of mechanical concepts as applied to human movement.
2. To study about the bone structure and cartilage
3. To study the structure, movements, and loads applied to spine, shoulder and hip.
4. To study about the fluid mechanic system applied to human body

Basic Biological Principles: Diffusion - surface tension and viscosity – characteristics – influencingfactors - biological applications. Introduction to mechanics: Review of principles of mechanics -vector mechanics- Resultant forces of Coplanar and Non-coplanar- Concurrent and non-concurrent forces - parallel force in space - Equilibrium of coplanar forces - Newton’s laws of motion -work and energy -moment of inertia. Fluid mechanics: Introduction - viscosity and capillary viscometer -rheological properties of blood - laminar flow -Couette flow and Hagen-poiseuille equation - turbulent flow.

Hard tissues: Bone structure - composition and mechanical properties of bone -, viscoelastic properties - Maxwell and Voight models – anisotropy -electrical properties of bone - fracture mechanism and crack propagation in bones - fracture fixators - repairing of bones - mechanical properties of collagen rich tissues, teeth and its properties.

Soft tissues: Structure and functions of cartilages, tendons – ligaments - stress-strain relationship - soft tissue mechanics - mechanical testing of soft tissues standard sample preparation - cross-section measurement - clamping of the specimen - strain measurement - environmental control, time dependent properties of testing.

Bones, joints and loco motor systems: Joints - classification based on structural, functional and regional- characters – mechanism of lubrication of synovial joints. Bone – composition-classification. Biomechanics of joints: Skeletal joints - basic considerations - basic assumption and limitations - forces and stresses - mechanics of the elbow, shoulder, spinal column, hip, knee and ankle.

Locomotion: Basis - gait analysis and goniometry –ergonomics -foot pressure measurements – force platform - mechanics of foot. Total Hip Prosthesis: requirements - types of components - Stress analysis and instrumentation, Knee Prosthesis. Cardiovascular mechanics: Heart valves - artificial valves - biological and mechanical valves development - testing.

REFERENCES

1. Donald R. Peterson and Joseph D. Bronzino, Biomechanics Principles and applications, CRC press, Taylor & Francis Group, LLC, 2008 .
2. Duane Knudson, Fundamentals of Biomechanics, Springer publication, 2nd Edition, 2007
3. R. McNeill Alexander, Biomechanics, Chapman and Hall, New York, 1975.
4. D. N.Ghista, Biomechanics of Medical Devices, Marcel Dekker, New York, 1982.
5. A Z Tohen and C T Thomas, Manual of Mechanical Orthopaedics
6. D N Ghista and Roaf, Orthopaedic Mechanics:Procedures and Devices, Academic Press, London, 1978.
7. V.C. Mow and W.C. Hayes, Basic Orthopedic Biomechanics, Lippincott- Raven Publishers, Philadelphia, 1997.

COURSE OUTCOME

Student will be able to

1. Understand the definition of biomechanics, prostheses orthoses and its classification and design principles.
2. Develop a better understanding of how mechanical principles influence human motion during everyday life.
3. Analyze the forces at joints for various static and dynamic human activities; analyze the stresses and strains in biological tissues.
4. Understand the principles of mechanics that is used to analyze human movement.

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓				✓		✓	
CO3	✓	✓	✓		✓		✓		
CO4	✓	✓		✓					✓

RHIC 204/ PTRHIC 204	ARTIFICIAL ORGAN SYSTEM	L	T	P
		4	0	0

COURSE OBJECTIVES

1. To understand the principles and biology underlying the design of implants and artificial organs.
2. To understand the fundamentals of materials used for manufacturing implants, prosthesis and orthoses that has wide application in healthcare industry.

Bio materials: Definition of biomaterials- Requirements of biomaterials- classification of biomaterials- Comparison of properties of some common biomaterials- Effects of physiological fluid on the properties of biomaterials- Biological responses (extra and intra-vascular system). Surface properties of materials- physical properties of materials-mechanical properties- Biomaterial outlook for organ transplant, design considerations.

Introduction to artificial organs: Biomaterials used in artificial organs and prostheses - inflammation, rejection, correction. Rheological properties of blood - blood viscosity variation- effect of shear rate –hematocrit- temperature and protein contents - Casson equation - flow properties of blood through the blood vessels - problems associated with extracorporeal blood flow.

Artificial Heart and circulatory assist devices: Engineering design of artificial heart and circulatory assist devices.Artificial kidney: Structure - function – filtration - basic methods of artificial waste removal –hemo dialysis - equation for artificial kidney - middle molecule hypothesis. Hemo dialysers: flat plate type - coil type - hollow fiber -analysis of mass transfer in dialysers - regeneration of dialysate - membrane configuration - wearable artificial kidney machine - separation of antigens from blood in ESRD patients.

Artificial heart-lung machine: Introduction - gaseous exchange / transport - artificial heart-lung devices. Oxygenators: bubble, film oxygenators and membrane oxygenators -gas flow rate and area for membrane oxygenators. Liver support system - artificial pancreas - blood - skin.

Audiometry: air conduction - bone conduction – masking– diagram. Hearing aids: Types - receiver amplifiers –opthalmoscope –retinoscope -I.A.B.P principle and application. Rehabilitation Engineering: Rehabs for locomotion, visual, speech and hearing -artificial limb and hands - prosthetic heart valves - gait study- spinal rehabilitation.

References:

1. Joseph D.Bronzino, The Biomedical Engineering Handbook, CRC Press, 2000.
2. Khandpur. R. S., Hand Book of Biomedical Instrumentation, Tata McGraw Hill Pub Co. Ltd., New Delhi,2nded., 2003.
3. Erie.D.Blom and Howard.B.Rothman,Artificial Organs, 1994.
4. David O. Cooney Biomedical Engineering Principles (Volume – II), Marcel Dekker Inc,New York, 1976.
5. Rory A Cooper; HisaichiOnabe; Douglas A. Hobson, Introduction to Rehabiliation

6. Engineering, CRC press, 2006.
7. E.Ballabio, Rehabilitation Engineering, IOS press, 1993.

COURSE OUTCOME

Student will be able to

1. Understand the concept of biocompatibility and the methods of biomaterial testing
2. Awareness about the testing of the biomaterials done biologically before implantation in the human body.
3. Gain knowledge in the existing designs of artificial organs.
4. Understanding the applications of the organs implants

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓				✓			
CO2	✓	✓							
CO3	✓	✓	✓		✓		✓		✓
CO4	✓	✓		✓					

RHIP-207/PTRHIP-404	**BIOMEDICAL INSTRUMENTATION LAB**	**L**	**T**	**P**
		0	**0**	**3**

LIST OF EXPERIMENTS **

1. Respiratory system analysis using Spirometer
2. ECG wave analysis using simulator
3. Real time patient monitoring system
4. 12-lead ECG measurement System
5. EMG Biofeedback with NCV
6. EMG Measurement system
7. Auditory system check up using Audiometer
8. ECG heart rate system with HRV
9. Heart sound measurement using PCG
10. Measurement of BP, Pulse and SPO2
11. Measurement of Giat Analysis
12. Design of Medical Amplifier

****The list of Experiments will be finalized by the course teacher in consultation with the HOD depending on the availability of equipments, the state of art and recent trends.**

RHIT 303	THESIS PHASE – I	L	T	P
		0	0	15

COURSE OBJECTIVES

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.

COURSE OUTCOMES

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

1. Take up any challenging practical problems and find solution
2. Learn to adopt systematic and step-by-step problem solving methodology

Mapping with Programme Outcomes									
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓			✓	✓	✓	✓	✓
CO2		✓		✓		✓	✓	✓	

RHII 304	INDUSTRIAL TRAINING	L	T	P
		0	0	2

COURSEOBJECTIVES

- To train the students in the field work related to process control and instrumentation and to have a practical knowledge in carrying out process control and instrumentation field related works.
- To train and develop skills in solving problems during execution of certain works related to process control and instrumentation.

The students individually undergo a training program in reputed concerns in the field of Process Control and Instrumentation during the summer vacation (at the end of second semester for full – time / fourth semester for part – time) for a minimum stipulated period of four weeks. At the end of the training, the student has to submit a detailed report on the training they had, within ten days from the commencement of the third semester for Full-time / fifth semester for part-time. The students will be evaluated by a team of staff members nominated by head of the department through a viva-voce examination.

COURSE OUTCOMES

1. The students can face the challenges in the practice with confidence.
2. The student will be benefited by the training with managing the situation arises during the execution of works related to Process Control and Instrumentation.

RHIT 401	THESIS PHASE – II	L	T	P
		0	0	15

COURSE OBJECTIVES

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.

COURSE OUTCOMES

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

1. Take up any challenging practical problems and find solution.
2. Learn to adopt systematic and step-by-step problem solving methodology.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓			✓	✓	✓	✓	✓
CO2		✓		✓		✓	✓	✓	

PROFESSIONAL ELECTIVES

PE I	MEDICAL IMAGE PROCESSING	L	T	P
		4	0	0

COURSE OBJECTIVES

1. To study the production of x-rays and its application to different medical Imaging techniques.
2. To study the different types of Radio diagnostic techniques.
3. To study the special imaging techniques used for visualizing the cross sections of the body.
4. To study the imaging of soft tissues using ultrasound technique

Introduction to Driving problems in biomedical imaging: Signal input - image matrix, digital image quality - digital image processing - picture archiving and communication system (PACS) -sources of imaging data acquisition and noise - elementary image processing - Grenander's Pattern Theory.

X-rays: Production X-rays - various components of radiographic systems - X-ray tube design - X-ray spectrum - rating charts of X-ray tubes. Electrical circuit for X-ray machine - filament circuits and mA control - HT circuits - KV control - control of exposure timers - collimators, scatter and grids - absorbed dose - basics of tables and arms - properties of X -ray films and screens - dark room accessories - types of X-ray tubes for various medical applications.

Fluoroscopy and angiography: Fluoroscopic imaging system – principle - specific system design. Digitalfluoroscopy-c-arm system -Digital Subtraction Angiography (DSA) - digital subtraction programming. Ultra Sound in Medicine: Introduction – generation - acoustic impedance - ultrasonic transducers and types - transmitter and detector principles - probe design - principles of image formation. Display system: Principles of A-mode, B-mode and M-mode display - scan conversion - image processing - Doppler Ultrasound andColour flow mapping -application of diagnostic ultra sound.

Magnetic Resonance Imaging (MRI): Introduction - principles- instrumentation – magnets - gradient system - RF coils receiver system - pulse sequence - image acquisition and reconstruction techniques -functional MRI - application of MRI. Radio isotope imaging / Nuclear medicine: Radio nuclides for imaging - radionuclide production: cyclotron production, reactor production, generator production. Rectilinear scanners - Linear scanners – SPECT – PET - Gamma Camera - Comparison of other tomographic techniques.

Infra red Imaging: Physics of thermography -imaging systems - clinical themography - liquid crystal thermography. Special imaging techniques: Cineradiography –cinefluorography - stereoscopic radiography - magnification radiography – microradiography – tomography - neutron radiography.

REFERENCES:

1. David J. Dowsett, Patrick A. Kenny, R. Eugene Johnston, The Physics of Diagnostic Imaging, Chapman & Hall Medical, Madras/London.2nd edition, 2006.
2. S. Webb, The Physics of Medical Imaging, Adam Hilger, Bristol.Taylor and Francis group, New York, 1988.
3. Rangaraj M. Rangayyan, Biomedical Image Analysis, CRC press, 2005.

COURSE OUTCOME

Student will

1. Get the clear domain knowledge about the various Medical Imaging techniques.
2. To understand the various diagnostic applications of the medical imaging techniques.
3. To apply the imaging modalities in the medical hospitals
4. To use the advanced techniques to diagnose the health problems

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓				✓			✓
CO2	✓	✓					✓		
CO3	✓	✓	✓		✓				
CO4	✓	✓		✓					

PE II	**MEDICAL DIAGNOSTICINSTRUMENTATION**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

1. To understand the basic principle, working and design of various automated diagnostic equipments.
2. To develop skills enabling Biomedical Engineers to serve Hospitals, National and International Industries and Government Agencies.
3. To develop core competency in the field of Biomedical Engineering to gain technical expertise in biology and medicine for effective contribution in the development and improvement of health care solutions.
4. To study various medical instrumentation systems, drug delivery systems and health management systems.

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Electrocardiograph: Fibrillators and Defibrillators - Pacemakers – Arrhythmia Simulator. Ventilators: Basic principles – generators -inspiratory phase - cycling mechanisms - expiratory phase - ventilatory adjuncts - anaesthetic machines.

Electro EncephaloGraph: Multi channel EEG recording system –epilepsy -evokedpotential – Visual, Auditory and Somatosensory - MEG (Magneto Encephalon Graph) -EEG bio feedback instrumentation. Sliding theory of contraction: Recording and analysis of EMG waveforms – fatigue characteristics - Muscle stimulators - nerve stimulators -nerve conduction velocity measurement.

Measurement of mechanics of breathing: Spirometer-Lung volumeand vital capacity - measurements of residual volume -pneumotachometer–airway resistance measurement - whole body plethysmography -intra-alveolar and thoracic pressure measurements -apnea Monitor -types of ventilators – pressure –volume and time controlled –flow -patient cycle ventilators –humidifiers –nebulizers -inhalators.

Diagnosis: Basic principles of echo technique - display techniques A, B and M mode - ultrasound as diagnostic tool – echocardiogram – abdomen – obstetrics –gynaecology - ophthalmology.

Heart lung machine: Disc and membrane type oxygenerators - finger pump - roller pump, - Haemo Dialyser unit – Lithotripsy -principles of cryogenic technique – application – endoscopy -laproscopy. Patient monitoring system: ICU - post operative – ICCU -single and multichannel telemetry. Transmission of Biosignals over telephone lines -digital central monitoring systems for patient monitoring.

REFERENCES:

1. Joseph J. Carr and John M. Brown, Introduction to Biomedical equipment technology, Pearson education, 4th edition, 2008.
2. John G.Webster, Medical Instrumentation Application and Design, Wiley India Edition, 3rdedition, 2007.
3. L. A. Geddes and L. E. Baker, Principles of Applied Biomedical Instrumentation, John Wiley Publications, 3rdEdition,2008.

COURSE OUTCOME

Student will be able to

1. Demonstrate the principles of electronics used in designing various diagnostic equipment.
2. Have in-depth knowledge about different streams in Biomedical Engineering with greater emphasis on health care equipments and the advanced technologies such as Telemedicine, Telemetry, Medical Imaging, etc.
3. Provide a better technical support with exposure to the hospitals and health care industry.
4. Understand the various techniques and applying for the betterment of the patients.

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓						✓	
CO2	✓	✓					✓		✓
CO3	✓	✓	✓		✓				
CO4	✓	✓		✓					

PE III	COMPUTATIONAL NEURO ENGINEERING	L	T	P
		4	0	0

COURSE OBJECTIVES

1. Neural engineering and rehabilitation research applies neuroscience and engineering methods to analyze central and peripheral nervous system function and to design clinical solutions to neurological disorders or injury.
2. To study the basics of Nervous system
3. To understand the development and arrangement of neural tissue
4. To study the neuronal disorders and injuries
5. To study the repairing and reconstruction mechanism of nervous system.

Introduction to computational neuroscience – motivation for biophysical modeling. Theory and modeling in neuroscience : Descriptive vs. functional models -Turing vs. neural computation. Introduction to anatomy and cellular basis of nervous system.Introduction to differential equations and theory of dynamical systems.

Equivalent circuit model: Electromotive, resistive and capacitive properties of cell membrane, change in membrane potential with distance, voltage clamp experiment and Hodgkin and Huxley's model of action potential.

Ionic channels – ionic currnets- experimental techniques : voltage and space clamp experiments. The Hodgkin-Huxley formalism – activation and inactivation kinetics – complete model for action potential generation.Hodgkin-Huxley vs Markov models.
Qualitative Hodgkin-Huxley theory – voltage clamp techniques – Hodgkin-Huxley equations methods. Simplified neuron models: Simplifications of the Hodgkin-Huxley model: FitzHugh – Nagumo- Rinzel model. Abstract Models: phase model – rate model – McCulloch-Pitts neuron – integrate and fire neuron model.

Synapses and synaptic plasticity – simplified and phenomenological models of synaptic functions.synaptic transmission: electrical and chemical. Gated transmission at the nerve muscle synapse and central synapses – neurotransmitters.Cellular basis of learning: synaptic plasticity – The Hebbian rule of learning – variations for the Hebbian rule. Long term synaptic potentiation and depression. Synaptic plasticity on different time scales.

Basics of modeling neural networks: The two or three levels of neural dynamics. Supervised learning rules : Perceptron learning rule - Adaptation in linear neurons, Widrow-Hoff rule – objective functions and gradient descent – multilayer networks and back propagation. Unsupervised learning rules : Principle Component Analysis – decorrelation – Winner-take-all networks and clustering. Basic neural network architectures: feed-forward – feedback – lateral connections.

REFERENCES:

1. Dayan P and L.F.Abbott, Theoretical Neuroscience: Computational and Mathematical modeling of neural systems, MIT Press, 2001.
2. W. Gerstner and W.M.Kistler, Spiking Neuron Models, Cambridge University Press, 2002.
3. Arabib M.A, Erdi P and Szentagothai J, Neural Organization: Structure, functions and dynamics, MIT Press, 1997.
4. Lauren Fausett, Fundamentals of Neural Networks, Prentice- Hall, New Jersey, 1994.

5. V.Z. Marmarelis, Advanced methods of physiological system modeling, Springer, 1989.

COURSE OUTCOME

Through this course of study students will be able to

1. Understand the application of basic science and engineering techniques,
2. Develop methods to record from and exert control over the nervous system
3. Understand and develop the models of associated organ systems.
4. Can carryout research in the analysis of memory of physiological systems

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓				✓	✓		
CO3	✓	✓	✓		✓				
CO4	✓	✓		✓					✓

PE IV	**COMPUTATIONAL METHODS AND CANCER MODELLING**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

1. Cancer Modelling is to analyze the origin of cancer and basics of Molecular Biology.
2. To study the cause for Cancer.
3. To understand the depth understanding of development of Cancer.
4. To study the various types of cancer and its treatment methods.
5. To study and design the mathematical models of various cancer.

Cancer: Definition, Benign Tumors Vs. Malignant Tumors, Types of Cancer, Common Symptoms, Molecular Hallmarks of Cancer - Growth Signal Autonomy, Evasion of Growth Inhibitory Signals, Evasion of Apoptosis (Programmed Cell Death), Unlimited Replicative Potential, Angiogenesis (Formation of New Blood Vessels), Invasion and Metastasis, Molecular Basis of Cancer - Cancer Genes (Oncogenes and Tumor Suppressor Genes), Carcinogenesis – A Multistep Process, Evidences for Multistage Models of Carcinogenesis

Global Cancer Incidence and Mortality: Data Source and Measurements, Overall Cancer Risk, Incidence and Mortality Patterns for Common Cancers, Issues in Interpreting Temporal Trends, Analytical Methods for Epidemiological Studies - Ecological Studies, Cross- Sectional Studies, Cohort Studies, Case-Control Studies, Interpretation of Epidemiology Findings, Molecular Epidemiology

Introduction to computational neuroscience – motivation for biophysical modeling. Theory and modeling in neuroscience : Descriptive vs. functional models -Turing vs. neural computation. Introduction to anatomy and cellular basis of nervous system. Introduction to differential equations and theory of dynamical systems.Equivalent circuit model: Electromotive, resistive and capacitive properties of cell membrane, change in membrane potential with distance, voltage clamp experiment and Hodgkin and Huxley's model of action potential.

Ionic channels – ionic currnets- experimental techniques : voltage and space clamp experiments. The Hodgkin-Huxley formalism – activation and inactivation kinetics – complete model for action potential generation.Hodgkin-Huxley vs Markov models.Qualitative Hodgkin-Huxley theory – voltage clamp techniques – Hodgkin-Huxley equations methods. Simplified neuron models: Simplifications of the Hodgkin-Huxley model: FitzHugh – Nagumo- Rinzel model.

Abstract Models: phase model – rate model – McCulloch-Pitts neuron – integrate and fire neuron model.Synapses and synaptic plasticity –simplified and phenomenological models of synaptic functions.synaptic transmission: electrical and chemical. Gated transmission -at the nerve muscle synapse and central synapses – neurotransmitters.

REFERENCES:

1. Dayan P and L.F.Abbott, Theoretical Neuroscience: Computational and Mathematical modeling of neural systems, MIT Press, 2001.
2. W. Gerstner and W.M.Kistler, Spiking Neuron Models, Cambridge University Press, 2002.
3. Arabib M.A, Erdi P and Szentagothai J, Neural Organization: Structure, functions and dynamics, MIT Press, 1997.
4. Teicher, Beverly A, Tumor Models in Cancer Research Series: Cancer Drug Discovery and Development , 2nd ed. Springer, 2011.
5. V.Z. Marmarelis, Advanced methods of physiological system modeling, Springer, 1989.

COURSE OUTCOME

Through this course of study students can able to
1. Understand the basics of molecular biology and cancer
2. Analyse how Cancer develops and progresses
3. Design the mathematical modelling and the causes of cancer can be analysed
4. Understandvarious treatments methods and Imaging of cancer and the research problems can be solved to the extent

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓				✓			
CO2	✓	✓							✓
CO3	✓	✓	✓		✓		✓		
CO4	✓	✓		✓					

PE V	**BIOSIGNAL PROCESSING**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

1. To build a strong base for developing algorithms for signal processing systems and Imaging systems.

2. To develop competency in terms of logical thinking, programming and application skills.
3. To train and motivate students for pursuing higher education and research for developing cutting edge technologies.

Signals and Systems: Introduction to discrete time signals and systems - Properties - LTI system. Signal conversion :conversion requirement for biomedical signals – signal conversion circuits. Discrete Fourier Transform (DFT) – properties – circular convolution – FFT computation using DIT and DIF algorithms.

FIR design: Windowing techniques – need and choice of windows – Linear phase characteristics. IIR design: Analog filter design –approximation methods – Warping - prewarping – Frequency transformation. Wavelet transformation: Introduction – basic principles.

Spectral analysis: Estimation of power density spectrum - periodogram - parametric model based spectral linear prediction theory - estimation using Auto Regressive (AR), Moving Average (MA) andAuto Regressive Moving Average (ARMA) models. Estimation of parameters- spectral error measure - EEG analysis.

Adaptive filters: Principle noise canceller model – 50 Hz adaptive cancelling using a sine wave model – maternal ECG cancellation in fetal electrocardiography - ECG QRS detection techniques – estimation of R-R interval – estimation of ST segment inclination – arrhythmia analysis monitoring – long term ECG recording – basics of ECG data reductiontechniques.

Electromuscular Signal Processing: Basic electromyography, EMG data acquisition, rectification and averaging. Neurological signal processing: The EEG Signals and its Characteristics - EEG Analysis - time frequency domain method -detection of spikes and spindles - detection of alpha, beta and gamma waves. Least squares and polynomial modelling: The Markov model and Markov chain -dynamics of sleep-wake Transition - hypnogram Model Parameters.

REFERENCES:

1. Rangaraj M Rangayyan: Biomedical Signal Analysis, John Wiley, 2002.
2. John G Proakis, Dimitris G Manolakis: Digital Signal Processing – Principles, Algorithms and Applications, Prentice Hall of India,4th edition, 2005.
3. P. Ramesh Babu: Digital Signal Processing, ScitechPublications,India,4th edition, 2007.
4. John L.Semmlow: Biosignal and Medical Image Processing – Matlab Based Applications,Marcel Dekker Inc., New York, 2nd edition, 2009.
5. D. C. Reddy, Biomedical Signal Processing – Principles and Techniques, Tata McGraw Hill Publishing company Ltd., 2nd reprint, 2006.

COURSE OUTCOME

Student will be able to

1. Understand the fundamental techniques and applications of digital signal processing with emphasis on biomedical signals.
2. Implement algorithms based on discrete time signals.
3. Understand Circular and linear convolution and their implementation using DFT analyse signals using discrete Fourier transform.
4. Understand efficient computation techniques such as DIT and DIF FFT algorithms

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓				✓			
CO2	✓	✓					✓		✓
CO3	✓	✓	✓		✓			✓	
CO4	✓	✓		✓					

PE VI	**TRANSPORTATION IN LIVING SYSTEMS**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

5. To familiarize the student with various transportation mechanism in living systems
6. To understand the concepts of organs
7. To study about the internal organs

Introduction: Organization of the human body – cells – tissues - different organs.
Heat transport: Body temperature regulation based on thermostat principle and its operation - transportation in tissues - muscle, skin and other organs in different environmental temperatures.

Transportation of fluids: Blood transport through internal organs –urogenitary - cardio pulmonary and central nervous system.

Gastro intestine system: Diffusion – osmosis - electro osmosis - ultra filtration -reverse osmosis through natural membrane and artificial synthetic membranes.

Lymph: Transportation through internal organs, urogenitary, cardio pulmonary, central nervous and gastro intestine systems. Problems on lymph transfer in human body.

Mass transfer: Constituents of blood, urine, mass transfer in kidney, skeletal, nervous, gastro intestine and cardio pulmonary systems. Comparison with artificial organs.

REFERENCES

1. David O.Cooney,An introduction to fluid, heat & mass transport process- Principles, Vol.1, Marcel Dekker Inc., Newyork, 1976.
2. William F. Ganong, Review of Medical Physiology, McGraw-Hill Medical; 22nd edition, 2005.
3. Charles Herbert Best, Norman Burke Taylor, John Burnard West, Best and Taylor's physiological basis of medical practice,Williams and Wilkins, Baltimore, 12th edition, 1991.

COURSE OUTCOME

1. Student will be able to understand the internal organs
2. Understanding of organs functioning in detail
3. Knowing the Physics involved in the body fluids

4. Helps in depth knowledge of human systems

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓							
CO3	✓	✓	✓		✓				
CO4	✓	✓		✓					

PE VII	**CANCER BIOLOGY**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

To familiarize the student with cancer and Molecular biology

Fundamentals of cancer biology : Regulation of cell cycle – Mutations that cause changes in signal molecules – Effect on receptor– Signal switches – Tumor suppressor genes – Modulation of cell cycle in cancer – Different forms of cancers, diet and cancer – Cancer screening and early detection – Detection using biochemical assays – Tumor markers – Molecular tools for early diagnosis of cancer.

Principles of carcinogenesis: Theory of carcinogenesis – Chemical carcinogenesis – Metabolism of carcinogenesis – X-ray radiation – Mechanism of radiation carcinogenesis.

Principles Of Molecular Cell Biology Of Cancer: Signal targets and cancer – Activation of kinases – Oncogenes – Identification of oncogenes –Retroviruses and oncogenes – Detection of oncogenes – Oncogenes/proto oncogene activity –Growth factors related to transformation – Telomerases.

Principles of cancer metastasis: Clinical significances of invasion – Heterogeneity of metastatic phenotype – Metastatic phenotype – Metastatic cascade – Basement membrane disruption – Three step theory of invasion – Proteinases and tumor cell invasion.

New molecules for cancer therapy: Different forms of therapy – Chemotherapy – Radiation therapy – Detection of cancers –Prediction of aggressiveness of cancer – Advances in cancer detection – Use of signal targets towards therapy of cancer.

REFERENCES:

1. Weinberg, R.A., The Biology of Cancer, Garland Science, 2007.
2. Pelengaris, S. and Khan. M., The Molecular Biology of Cancer, Blackwell Publishing, 2006.
3. Macdonald, F. and Ford, C.H.J., Molecular Biology of Cancer, BIOS ScientificPublication, 2005
4. Roger John Benjamin King, Mike W. Robins, Cancer Biology, Pearson prentice hall, 3rd edition, 2006.
5. Ruddon, R. W., Cancer Biology, Oxford University Press, 2nd Edition, 1995

COURSE OUTCOME

Student will be able to

1. Have clear understanding of basics of cancer and its types
2. Understand the causes of Cancer
3. Analyse the modalities for the detection of Cancer
4. Develop cancer detecting modules

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓				✓		✓	✓
CO2	✓	✓					✓		
CO3	✓	✓	✓		✓				
CO4	✓	✓		✓					✓

PE VIII	**COMPUTATIONAL METHODS AND BONE MODELLING**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

1.To study about the Mathematical Modelling

2.To have knowledge on the Anatomy and physiology of Bones

3.To know how Cancer developes in Bones and affects its function

Introduction to Bone Tissues- structure of bone tissues –primary and secondary bone- compact and cancellous bones- other types. Mechanical properties of materials and bones- elastic properties-strength-fracture mechanics properties- Modelling fracture in tension- as a composite- micro damage- Modelling and reconstruction: need for feedback control- Bone Modelling of cancellous bone- functions of internal remodeling- changing the grain.

Techniques associated with the study of bone- new material on computational methods, imaging of bone structure- strain gauging of live animals - Clinically related issues- elementary stress analysis of bone - bone prostheses and implants - non-invasive measurement of bone integrity.

Introduction to computational neuroscience – motivation for biophysical modeling. Theory and modeling in neuroscience: Descriptive vs. functional models -Turing vs. neural computation. Introduction to anatomy and cellular basis of nervous system.Introduction to differential equations and theory of dynamical systems.Equivalent circuit model: Electromotive, resistive and capacitive properties of cell membrane, change in membrane potential with distance, voltage clamp experiment and Hodgkin and Huxley's model of action potential.

Ionic channels – ionic currents- experimental techniques: voltage and space clamp experiments. The Hodgkin-Huxley formalism – activation and inactivation kinetics – complete model for action potential generation.Hodgkin-Huxley vs Markov

models.Qualitative Hodgkin-Huxley theory – voltage clamp techniques – Hodgkin-Huxley equations methods. Simplified neuron models: Simplifications of the Hodgkin-Huxley model: FitzHugh – Nagumo- Rinzel model.

Abstract Models: phase model – rate model – McCulloch-Pitts neuron – integrate and fire neuron model.Synapses and synaptic plasticity – simplified and phenomenological models of synaptic functions. Synaptic transmission: electrical and chemical. Gated transmission at the nerve muscle synapse and central synapses – neurotransmitters.

REFERENCES:

1. Stephen C. Cowin, **"** Bone Mechanics Handbook, Second Edition**",**CRC Press, 2001
2. John D. Currey**,**. "Bones: structure and mechanics", Princeton University Press, 2002.
3. Arabib M.A, Erdi P and Szentagothai J, Neural Organization: Structure, functions and dynamics, MIT Press, 1997.
4. Teicher, Beverly A, Tumor Models in Cancer Research Series: Cancer Drug Discovery and Development , 2nd ed. Springer, 2011.

COURSE OUTCOME

Student will be able to

1. Understand the types of bone tissues and its structures
2. Analyse the causes of Bone Cancer
3. Model the different types of bones and Cancer affected Bones
4. Do research on the theraptics on Bone Cancer

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓				✓		✓	
CO3	✓	✓	✓		✓		✓	✓	
CO4	✓	✓		✓				✓	✓

PE IX	**MEDICAL IMAGING SYSTEMS AND RADIO THERAPY**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

1. To acquire knowledge about the various medical imaging techniques
2. To understand the fundamental principle and working of the medical imaging systems involved in the diagnosis of health care.

X – RAYS :Principle and production of soft X – Rays, Selection of anodes, heel pattern, Scattered Radiation, Porter-Bucky systems, Cooling System, Testing for various parameters of the unit, principles of Angiography and Fluoroscopic Techniques, Image Intensifiers, Single plane and bi plane recording units, digital subtraction angiography,mammography,dental X- ray units.

TOMOGRAPHY: Principle, Plane of Movement, Multisection Radiography, Computerised Axial Tomography, Type of Detection, image reconstruction, Spiral CT, Transverse Tomography, 3D Imaging.

EMISSION IMAGING: Alpha, Beta, Gamma Emission, different types of Radiation Detectors, G.M. & Proportional Counters, Pulse Height Analysers, Isotopic, Scanners, Isotopic Diagnosis of RBC Destruction Rate, GI Bleedings Iron Concentration, Liver Functions, Functions of Gamma Camera, PET, SPECT,PET/CT.

MAGNETIC RESONANCE IMAGING: Principle of MRI, MRI instrumentation, Imaging Different Sections of the Body, Tissue Characterization, MR Spectroscopy, Functional MRI.

THERAPY USING X – RAYS AND ISOTOPES 9 Direct and Indirect effects of high energy radiation, Units for radiation Exposure, Depth Dose curves, Linear Accelerator Betatron, Cobalt and Cesium Therapy, Computation of Absorbed Dose Level, Automatic Treatment Planning, Hazardous Effects of Radiation, Radiation measuring units, Allowed Levels, ICRP regulation Protection Methods.

REFERENCES:

1. Chesney D.N~ and Chesney M.O., X-Ray Equipments for Students Radiographer, Blackwell Scientific Publications, Oxford, 1971
2. Alexander, Kalender and Linke, Computer Tomography, John Wiley, Chich~ster, 1986.
3. Steve Webb, The Physics of Medical Imaging, Adam Hilger, Philadelpia,1988.
4. Peggy. W, Roger.D.Ferimarch, MRI for Technologists, McGraw Hill Publications,New York, 1995.
5. Donald Graham, Paul Cloke, Martin Vosper -Principles of Radiological physics, Churchill Livingston, 5th Edition.
6. Donald W.McRobbice, Elizabeth A.Moore, Martin J.Grave and Martin R.Prince MRI from picture to proton ,Cambridge University press, New York 2006.
7. Jerry L.Prince and JnathanM.Links," Medical Imaging Signals and Systems"- Pearson Education Inc. 2006

COURSE OUTCOME

Student will be able to

1. Understand the different methods and modalities used for medical imaging.
2. Learn the preferred medical imaging methods for routine clinical applications.
3. Understand the engineering models used to describe and analyze medical images
4. Apply these tools to different problems in medical imaging.

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓				✓		✓	
CO2	✓	✓				✓	✓		✓
CO3	✓	✓	✓		✓			✓	
CO4	✓	✓		✓		✓			

PE X	WAVELET TRANSFORMS AND ITS APPLICATIONS	L	T	P	C
		4	0	0	3

COURSE OBJECTIVES

1. To learn the fundamental concepts of wavelet
2. To apply the wavelet techniques for various biomedical signals.
3. To do analysis with the signals and processing

INTRODUCTION TO WAVELETS Introduction to Multirate signal processing- Decimation and Interpolation, Quadrature Mirror Filters, Subband coding, Limitations of Fourier transform, Short time Fourier transform and its drawbacks, Continuous Wavelet transform, Time frequency representation, Wavelet System and its characteristics, Orthogonal and Orthonormal functions and function spaces.

MULTIRESOLUTION CONCEPT AND DISCRETE WAVELET TRANSFORM :Multiresolution formulation of wavelet systems- signal spaces, scaling function, wavelet function and its properties, Multiresolution analysis, Haar scaling and wavelet function, Filter banks- Analysis and Synthesis, 1D and 2D Discrete wavelet transform, Wavelet Packets, Tree structured filter bank, Multichannel filter bank, Undecimated wavelet transform.

WAVELET SYSTEM DESIGN: Refinement relation for orthogonal wavelet systems, Restrictions on filter coefficients, Design of Daubechies orthogonal wavelet system coefficients, Design of Coiflet and Symlet wavelets.

WAVELET FAMILIES: Continuous Wavelets- Properties of Mexican hat wavelet, Morlet, Gaussian and Meyer wavelets. Orthogonal wavelets- Properties of Haar wavelets, Daubechies wavelets, Symlets, Coiflets and Discrete Meyer wavelets.Properties of Biorthogonal wavelets, Applications of wavelet families.

WAVELET APPLICATIONS: Denoising of Signals and Images, Image enhancement, Edge detection, Image Fusion, Image compression, Wavelet based feature extraction, Analysis of phonocardiogram signals, Analysis of EEG signals, Speech enhancement for hearing aids.

REFERENCES:

1. M.Vetterli and J. Kovacevic, ‘Wavelets and sub band coding’, Prentice Hall, 1995.
2. C.SidneyBurrus, Ramesh Gopinath&HaitoGuo, ‘Introduction to wavelets and wavelet transform’, Prentice Hall, 1998.
3. MetinAkay, ‘Time frequency and wavelets in biomedical signal processing’, Wiley-IEEE Press, October 1997.
4. Raguveer m Rao&Ajith S. Bopardikar, ‘Wavelet transforms – Introduction to theory and applications’, Addison Wesley, 1998
5. S.Mallet, ‘A Wavelet tour of signal processing’, Academic Press 1998
6. G.Strang and T.Nguyen, ‘Wavelet and filter banks’, Wesley and Cambridge Press.
7. P.P.Vaidyanathan, ‘Multi rate systems and filter banks’, Prentice Hall 1993.

COURSE OUTCOME

Student will be able to

1. Understand an in-depth knowledge about the basic concepts of wavelet and speech analysis

2. Apply wavelet for various physiological signals
3. Analyse the signal features and its functions
4. Do mathematical analysis on various types of Bio signals

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓						✓	
CO3	✓	✓	✓		✓		✓		
CO4	✓	✓		✓		✓			✓

PE XI	**BIOINFORMATICS**	**L**	**T**	**P**	**C**
		4	**0**	**0**	**3**

COURSE OBJECTIVES

1. To impart knowledge on various aspects of bioinformatics
2. To study in detail about DNA and its formation

Basic Concepts of Molecular Biology: Cells - Chromosomes, DNA, RNA, Proteins, Central dogma of molecular biology, Genomes and Genes - Genetic code, Transcription, Translation and Protein synthesis. Web based genomic and proteomic data bases: NCBI, Gen Bank.

Sequence alignments: Dot plot-Pair-wise sequence alignments - local and global -Sequence similarity and distance measures - Smith-Waterman algorithm, Needleman-Wunch algorithm, Multiple sequence alignment –Sum-of-Pairs measure - Star and tree alignments – PAM and BLOSUM, Phylogenetic analysis.

Informational view of Genomic data: Genomic Signal Processing- DNA Spectrograms- Identification of protein coding regions- Gene expression- Microarrays, Microarray image analysis.

Gene structure in Prokaryotes and Eukaryotes: Molecular Structure Prediction- Basic concepts and terminologies related to molecular structures- Basic molecular Visualization- RNA secondary structure prediction- Protein folding problem- Protein Threading- Protein Visualization- Introduction to Drug Discovery.

Software Tools: Use of Tools for basic and specialized sequence processing such as: BLAST, FASTA, RasMol, Phylip, ClustalW.

REFERENCES:

1. Setubal, Meidanis, Introduction to Computational Molecular Biology, Thomson: Brooks/Cole, International Student Edition, 2003

2. Jean-Michel Claverie, Cedric Notredame,Bioinformatics - A Beginners Guide, Wiley-Dreamtech India Pvt Ltd, 2nd edition, 2007.
3. Lesk, Introduction to Bioinformatics, Oxford University Press, Indian Edition, 3rd edition, 2008.
4. Higgins and Taylor,DesHiggins, Willie R. Taylor,Bioinformatics: Sequence, structure and databanks, Oxford University Press, Indian Edition, 2003
5. Bryan P. Bergeron, Bioinformatics Computing, Prentice hall of India, 2003
6. Jiang, Xu and Zhang, Current topics in Computational Molecular Biology, Ane Books, New Delhi, 2004.

COURSE OUTCOME

Student will be able to

1. understand the concept of Gene structures
2. awareness about the computational biology
3. work with various software tools
4. understands the various aspects of informatics applied in health industry so that quality of health care is improved.

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓					✓		
CO2	✓	✓				✓		✓	
CO3	✓	✓	✓		✓				✓
CO4	✓	✓		✓					

PE XII	**MEDICAL ETHICS AND STANDARDS**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

1. Achieve familiarity with some basic ethical framework& understand how these ethicalframeworks can help us to think through contemporary questions in medical ethics.
2. Students will be able to know about the legal and ethical principles and application of theseprinciples in health care settings & gain knowledge about the medical standards that to befollowed in hospitals.

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

ETHICAL THEORIES & MORAL PRINCIPLES: Theories-Deontology &Utilitarianism ,Casuist theory, Virtue theory, The Right Theory. Principles-NonMaleficence, Beneficence, Autonomy, Veracity, Justice. Autonomy & Confidentiality issues in medical practice, Ethical

Issues in biomedical research ,Bioethical issues in Human Genetics & Reproductive Medicine

HOSPITAL ACCREDITATION STANDRADS: Accrediation- JCI Accreditation & its Policies. Patient centered standards, Healthcare Organization management standards.

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

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

REFERENCES

1. Domiel A Vallero "Biomedical Ethics for Engineers", Elsevier Pub.1st edition, 2007
2. Biomedical Ethics: A Canadian Focus. Johnna Fisher (ed.), Oxford University Press Canada (2009)
3. Robert M Veatch" Basics of Bio Ethics", Second Edition. Prentice- Hall,Inc 2003
4. Physical Environment Online: A Guide to The Joint Commission's Safety Standards is published by HCPro, Inc. 2010
5. Joint Commission Accreditation Standards for Hospitals ,2nd edition 2003
6. Ben Mepham, ,Bioethics-"An Introduction for the biosciences", 2nd edition 2008, Oxford.

COURSE OUTCOME

Upon completion of this course the student should be able to demonstrate a measurable increasein their knowledge, skills and abilities related to:

1. Legal and professional guidelines for the health professions
2. Public duties and consent
3. Guidelines to obtain medical standards in hospitals.
4. Medical ethics, legal ethics and the differences associated with the medical society

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓				✓		✓	✓
CO2	✓	✓					✓		
CO3	✓	✓	✓		✓				✓
CO4	✓	✓		✓			✓		

OPEN ELECTIVES

OE I	COMPUTERS IN MEDICINE	L	T	P
		4	0	0

COURSE OBJECTIVES

1. To familiarize the student with use of computers in medicine
2. To use computers for bio signal analysis
3. To automate the hospitals with the help of computers

Introduction: Computer hardware and software - programming languages - use in medical field - need of computing hospitals - cost effectiveness - help of computerization to physicians.

Patient data base management: Computerized medical records - security. Computer in clinical laboratory -database approach - automated clinical laboratory and analysis - computerized specimen analysis - analysis of ECG, EEG and EMG. Chromosome analysis by computer - computerized cytology and histogram - automated scanning for cervical cancer.

Basics of computer assisted medical imaging: Nuclear medicine - digital subtraction radiography – computerized ultra sonography – X-ray, CT, Nuclear magnetic resonance. Basics of computer assisted medical decision making - general model algorithms - fuzzy set theory - cognitive set theory - cognitive models - QMR, KES and TIA.

Computer in intensive care units: metabolic balance up keeping- pulmonary function evaluation- Cardio vascular evaluation- Computer assisted therapy- computer for case of renal disorders.

Computer aids for the handicapped: basic discussion with examples- introduction to computer assisted instruction in medicine- ISDN in medicine.

REFERENCE:

1. R.D. Lele, Computers in medicine, Tata McGraw-Hill Publishing Company Limited, 2nd reprint, 2008.

COURSE OUTCOME

Student will be able to

1. Exposed to PC hardware as well as various microprocessor family
2. Hardware behind data acquisition
3. Scope of virtual reality in health care
4. Develop an insight knowledge about the biometrics and network security

Mapping of COs with Pos									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓						✓	
CO2	✓	✓				✓			

CO3	✓	✓	✓		✓		✓		✓
CO4	✓	✓		✓					

OE II	**TISSUE AND STEM CELL ENGINEERING**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

1. To understand basics of Tissue Engineering
2. To understand fundamentals of cell mechanisms
3. To teach the Physical & biological principles that serve as the scientific basis for understanding the interactions of biological molecules and cells with biomaterials employed for the fabrication of permanent implantable prostheses and as matrices for tissue engineering.
4. To understand application of Tissue Engineering

Tissue: Definition -structure - organization and types. Vascularity and angiogenesis - basic wound healing - cell migration - therapeutic and in-vitro testing.

Cell: Types – differentiations - different kind of matrix - cell-cell interaction. Cell culture: expansion – transfer - storage - characterization. Molecular biology: Cell signalling molecules - hormone - growth factor and delivery in tissue engineering. Cell attachment: differential cell adhesion - receptor-ligand binding - cell surface markers.

Scaffold and transplant: Biomaterials for tissue engineering -degradable materials (collagen, silk and polylactic acid) – porosity - mechanical strength - 3-D architecture - cell incorporation. Tissues for replacing bone–cartilage–tendons–ligaments - skin and liver.Basic transplant immunology - stems cells–introduction -haematopoiesis.

Case study: cell transplantation for liver – musculoskeletal - cardiovascular and neural systems. Ethical - FDA and regulatory issues of tissue engineering.

Stem Cells: Origin, characterization, potential applications of human stem cells- Protocols for isolation and identification of stem cells – Differentiation of cells from human- neurospheres into neurons – astrocytes and oligodendrocytes –Immuno labelling. Gene therapy: immune rejection in stem cell therapy – new therapy for autoimmune disease – prenatal diagnosis of genetic abnormalities using fetal CD34+ stem cells.

REFERENCES:

1. Sameul E Lynch, De Robertis, J Geng, Tissue Engineering, Elsevier, 3rd Edition, 2007.
2. Clemens van Blitterswijk, Tissue Engineering, Academic Press, 2008
3. Robert. P.Lanza, Robert Langer & William L. Chick, Principles of Tissue Engineering, Academic Press,2007.
4. B. Palsson, J.A. Hubbell, R.Plonsey and J.D. Bronzino, Tissue Engineering, CRC Press, 2003.
5. Kursad and Purksen, Embryonic Stemcell, Humana Press, 2002.

COURSE OUTCOME

By successfully completing this course, students will be able to:

1. Understand the importance of tissue engineering in the field of biomedical engineering
2. Understand the mechanisms involved in interaction of different materials with cells and tissues
3. Explain different methods involved in characterization and preparation of biomaterials in tissue engineering.
4. Apply the knowledge in creating new models in drug delivery systems using synthetic and basic knowledge on stem cells and its various functional applications and therapy.

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓						✓	
CO2	✓	✓					✓		
CO3	✓	✓	✓		✓				✓
CO4	✓	✓		✓					✓

OE III	**HOSPITAL ENGINEERING**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

1. To expose the students to planning and operation of hospitals in a detailed manner which will
2. include all facets of hospital planning activities covering every department that is involved both inclinical care as well as supportive services.
3. With an objective of imbibing a professional approach amongst students towards hospitalmanagement.
4. The subject encompasses management principles, staffing and marketing processes,discussing their significance and role in effective and efficient management of health careorganizations.

Hospital Engineering: General and specialized hospital, primary health care – their role and functions. Hospital services: inpatient, outpatient and emergency. Location and environment of hospital – Hierarchy of medical and paramedical staff & their functions and responsibilities – Modern Hospital Architecture- space in a hospital building– design of ward, intensive care units, air conditioning, plumbing & sanitation, gas supply, waste disposal, cleaning, dietary, sterilizing, laundry, storage and operation theatre systems, radiology, central labs, blood banks, OPD, Casualty.

Electrical systems in hospitals: Safety and protective systems. Design of sub stations, breakers, surge protectors, EMI filters, voltage stabilizers, generator sets and Uninterrupted Power Supply for ICU and computerized monitoring units. Specification and estimation for hospital wiring - case study.

Air conditioning & gas supply systems: Air conditioning and refrigeration systems for small and large areas. Air changes, filtering and sterility.Deodorization- disinfection-dehumidification and cryogenic systems- Centralized supply of air, oxygen, nitrous oxide and vacuum, liquid oxygen.Management of lifts and fire fighting equipments.

Hospital Management: Importance of RI department – servicing and maintenance, testing, acceptance and maintenance protocols, MROs. Training of men for medical equipments preventive and periodical maintenance procedures- Preparation of estimates, specifications, tender details etc. Importance of ISO 9000 certificates - obtaining ISO certificates in hospitals.

Hospital Information system: Role of database in HIS- Need of Networking in HIS-Overview of Networking, topologies and configuration. Structuring medical records to carry out functions like admissions, discharges, treatment history etc. Computerization in pharmacy & billing.Automated clinical laboratory systems & radiology information system.

REFERENCES:

1. Harold E. Smalley, Hospital Management Engineering – A guide to the improvement of hospital management system, PHI, 2003.
2. Sharma, Essentials for Hospital Support Services and Physical Infrastructure, Jaypee Medical Publishers,1/e, 2003.
3. C. A. Caceras, The Practice of Clinical Engineering**,** Academic Press, New York, 1977.
4. C.S. Ward, A.J. Davey, J.T.B. Moyle, Ward's Anaesthetic Equipment,W.B. Saunders Company, 4th edition, 1992.
5. Bhaumick and Bhattachary, EHV Substation equipments.
6. Alexander Kusko, Emergency and Standby Power Systems, McGraw-Hill, 1989.
7. BalaguneSwamy, Reliability Engineering.
8. Anantha Narayanan, Basic Refrigeration and Air Conditioning, Tata McGraw-Hill, 3rd edition, 2006.

COURSE OUTCOME

The student will be able to

1. Follow the newest findings in the area of hospital planning, health consultancy, hospital waste and implement the perspectives in constructing hospital standards.
2. Acquires knowledge of the principles and practices essential for managing a hospital organization.
3. Well acquainted with the knowledge about the significance and role in effective and efficient management of human resources in health care organizations
4. Service and analyse the Medical equipment which is a most societal need.

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓						✓	
CO2	✓	✓				✓			
CO3	✓	✓	✓		✓		✓		✓
CO4	✓	✓		✓				✓	

OE IV	TELEMEDICINE	L	T	P
		4	0	0

COURSE OBJECTIVES

1. To teach the key principles for telemedicine and health.
2. To enable the students with the knowledge of telemedical standards, mobile telemedicine and its applications.

Telemedicine, telehealth and telecare: History of telemedicine- Main phases of telemedicine- Pre electronic telemedicine. Electronic telemedicine Technical Requirements - Type of information and standards, audio, data, Fax, Video Types of communications and networking- networking architecture. POTS, ISDN, ATM Other Fixed networks- Air/airless communications, RF, Microwaves, Satellite, GSM, CDPD (Cellular Digital Packet Data) Acquisition/ displays- Acquisition systems Cameras, Scanners, Other medical specialized acquisition system.

Display systems: Analogue devices, LCD, Laser displays, Holographic representations, Virtual screen devices Computation / storage systems: Magnetic, Mixed, Optical (laser) devices (only brief description required).

Telemedicine applications: Teleradiology: Basic parts of a teleradiography system, Image acquisition and management, display, communication, interpretation Telepathology: Applications, requirements, security and confidentiality tools, telequantitation at distance. Telecytology: Applications, Telecardiology: requirements, portable solutions Telehome-Care Home based applications, Teleoncology: Applications, Telesurgery, telepsychiatry, Teledermatology Techniques.

Internet in telemedicine: Basic concepts - Security – secure socket layer – Firewalls – proxies. Personal Communication, Medical data sharing needs for telemedicine -Internet problems, Distant training, teleworking and telecasting. Ethical and legal aspects of telemedicine: confidentiality, patient rights and consent-ethical and legal aspects of internet-telemedical malpractice.

Constraints for the wide spread use of telemedicine: constraints linked to economy, social acceptance Strategic planning for telemedicine implementation. Analysis of the present situation and the demand Objectives and strategies- Plan of implementation, Forces affecting technology transfer scenarios for telemedicine.

REFERENCES:

1. Olga Ferrer, Roca M. Sosa, Marcelo C, Handbook of telemedicine, IOS Press, 3rd edition, 2002.
2. Ling Guan, Multimedia image and video processing, CRC Press 2000.
3. Thorsten M Buzug, Heinz Handels, Dietrich Holz, Telemedicine: Medicine and Communication, Springer – Verlag, 2001
4. Douglas V. Goldstein, e-Healthcare: Harness the power of Internet, e-commerce and e-care, Jones and Barlett Publishers.
5. A. C. Norris, Essentials of Telemedicine and Telecare, John Wiley& Sons 2002.

COURSE OUTCOME

The student is exposed to the

1. Technologies applied in multimedia using telemedicine
2. Protocols behind encryption techniques for secure transmission of data.
3. Applications of telehealth in healthcare
4. Concept of the fundamental concepts necessary to for any telemedicine and telehealth activity

Mapping of COs with Pos								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO8**	**PO9**
CO1	✓	✓						
CO2	✓	✓						
CO3	✓	✓	✓		✓		✓	
CO4	✓	✓		✓		✓		✓

OE V	**VISION IMPAIRMENT AND THERAPY**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

1. To impart knowledge on various vision impairment and associated therapy
2. To have knowledge on visual aids and its functions

Visual Impairment: Definitions and categories – Causes- hereditary- congenital - adventitious. Concept of impairment - international classification of impairment including ICF 2005 - definition and classification of blindness and low vision - incidence and prevalence of visual impairment.

Eye and Eye care: Visual Acuity – refraction – fusion - depth perception -visual deficit tunnel vision - loss of visual field - central scotoma - low vision -refractive errors –myopia – hyperopia – persbiopia- astigmatism. Physical Medicine and Eye Diseases: Electotherapy- Actinotherapy - Occular Prosthetics - Eye Bank. Common eye diseases:Cataract–glaucoma– traucoma - corneal ulcer –Xerophthalmia - retinitis pigmentosa - macular degeneration - optic atrophy.

Education of Low Vision Children: Assessment of low vision - educational problems of low vision children - vision stimulation and visual efficiency - low vision aids – magnifiers - large print materials - computers. Education of low vision children with associated intellectual impairment - hearing impairment and neurological impairment including classifications - assessment - teaching strategies.

Psycho-social Implications of Visual Impairment: Psychological and social implications of visual impairment - effects of blindness on growth and development -physical, social, intellectual and emotional. Effects of visual impairment on personality development - verbalism and mannerism.

Social Disposition to Visual Impairment: Attitude towards visual disability-parental attitudes - attitude of siblings - peer group attitude and stereotypic attitude towards blindness.

Teachers' attitudes - social attitudes - attitude modification - role of teacher in developing positive Attitude. Visually Impaired Children with Associated Disabilities**:** Concept - Types of associated disabilities -hearing impairment - mental retardation -locomotor and neurological disorders - learning disabilities -importance of early intervention- support services -modify and implications.

REFERENCES

1. Mani. M.N.G, Techniques of Teaching Blind Children. New Delhi:Sterling Publishers, 1992
2. Mani. M.N.G, Concept Development of Blind Children. Coimbatore: SriRamakrishna Vidyalaya Printing Press, 1992.
3. Mani. M.N.G. Ingredients of IED.Mukkimalai:Nivis Publishers, 1992.
4. Moores. D.F. Educating the Deaf: Psychology, Principles and Practices, Princeton, NJ: Houghton Mifflin, 5th edition, 2001.
5. R. S. Pandey, LalAdvani Perspectives in Disability and Rehabilitation.New Delhi: Vikas Publishing House,1995.
6. Punani. B and Rawal. N (1997). Community Based Rehabilitation (Visually Impaired).Bombay: NAB.

COURSE OUTCOME

Student will be able to

1. understand the concept of various vision impairments
2. aware about various therapeutic measures for vision impairments
3. gain knowledge in the recovery and design of therapeutic equipments
4. Do the research analysis on the Theraptical side

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓					✓		
CO2	✓	✓				✓			
CO3	✓	✓	✓		✓			✓	
CO4	✓	✓		✓					✓

OE VI	**HEARING IMPAIRMENT AND THERAPY**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

1. To impart knowledge on various hearing impairment and associated therapy
2. To study about the syndromes and speech processors

Medical Rehabilitation of Persons with Hearing Impairment(HI) : Introduction and advantages of early identification for children with HI - consequences of late identification of HI –screening modes and durations - advantages and disadvantages of current screening methods - preferred model for hearing screening and follow up. The Management of deafness

in children: Multi disciplinary management - the corner stone of effective habilitation-medical management - investigating the causes of deafness - genetic counselling.

Syndromes related to persons with Hearing Impairment: Cleidocranial Dysplasia Syndrome - Usher's syndrome –Treacher Collins –Hemifacial Microsomis – Neurofibromatosis - Waardenburg Syndrome.Cochlear Implantation and management in deaf children: Sensation and processing of sound and selection criteria - cochlear implants - pre-operative investigations, assessment and adjustment of speech processor - cost-effectiveness and evaluation of cochlear implants -pre-implant counselling and formal evaluation - fitting / tune-up, Follow-up of Aural Rehabilitation.

Auditory-verbal therapy: Existing and emerging trend–philosophy - principles of auditory-verbal practice- therapy process. Auditory verbal: Basic components -preparation, implementation and effectiveness -manpower development -assistive devices - cochlear implant as a tool. Social and vocational rehabilitation of persons with Hearing Impairment: Misconceptions and facts relating to Hearing Impairment - public awareness - pre-vocational and vocational assessment.

Psycholinguistics for the persons with Hearing Impairment: Parts of the brain - functions and organisation of language in the brain - anatomy of language - Broca's area, Wrenicke's area. The organisation of the brain - Fundamental of the cortex -Major and minor hemispheres - language modality and the brain -the effects of spatialization of language - inter play between language and visual spatial cognition.

Education and Assistive Technology for Children with Hearing Impairment: The Concept of Education Technology - need and important of education technology -meaning concept and nature of education technology. Defining Assistive Technology: Accommodation –adaptation -common types of assistive technology - uses of assistive technology - appropriate assistive technology. Assistive Devices: Amplifying devices- induction loop system -alerting systems – speech to text transcription.

REFERENCES:

1. Graham Martin Ballantyne's Deafness edited by John Graham, Mike Martin, John Graham, David Baguley,7th edition, 2009.
2. TureJohnson, Inclusive Education, VNDP Inter-Regional programmes fordisabled people, 1995
3. Bamford and Saunders, Hearing Impaired, auditory perception andlanguage disability, New Delhi; LakshmanchandArya Publishing Company, 1994
4. Richard.W. Fling, History of Hearing Impairment.New Delhi; A.I.T.B.S.Publishers, 1995

COURSE OUTCOME

Student will be able to

1. Understand the deafness and associated problems
2. Understand the concepts of brain activities associated with hearing
3. Study about hearing impairment and its therapy importance
4. Design the devices for impairments

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							✓
CO2	✓	✓				✓		✓	

CO3	✓	✓	✓		✓		✓		
CO4	✓	✓		✓		✓			

OE VII	**AUDIOLOGY AND SPEECH THERAPY**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

1. To familiarize the student with audiology and impart knowledge on various speech therapy
2. To Know about the auditory mechanisms

Auditory Mechanism: Phylogeny - basic embryology - development of the ear - Outer ear, Middle ear, Inner ear -anatomy of the ear through temporal bone -physiology of hearing - auditory nerve - brainstem pathway.

Audiology: Lineage of audiology - visual reinforcement audiometry - puretone audiometry – equipment –procedure -interpretation of audiograms -educational and rehabilitation implications. Tympanometry / Impedance Audiometry: Equipment –procedure -interpretation of audiograms - educational and rehabilitation implications -speech and electric response audiometry.

Hearing Aids and Ear Moulds: Hearing aid as a system - history and development of hearing aids - hearing aid orientation and counselling. Components and characteristics of hearing aids: Types - body worn -ear level - bone conduction- CROS -extended frequency -group hearing aids -digital programmable hearing systems.Hearing aid selection and evaluation: Ear moulds–requirements – types -process of making an ear mould, care and maintenance.

Speech as a human function : Definition -anatomy of speech organs - speech mechanism - respiratory organs - phonatory organs - articulatory organs - development of speech in hearing children - development of speech in hearing impaired children - Supra-segmental aspects of speech - seven stage development .

Phonetics, Speech problems and Correction: Phonetics - basic concepts -introduction to International Phonetic Alphabet -articulatory aspects of phonetics -acoustic phonetics -perceptual phonetics.Phonation and Voice Production- learning and teaching speech - speech problems, correction and evaluation - voice problems and therapy.

References:

1. Frederick N. Martin, John Greer Clark, Introduction toAudiology U.S.A,Allyn and Bacon.9th edition, 2006.
2. Hayes A. Newby, Gerald R. Popelka,Audiology, U.S.A.; Prentice - Hall International., 6th edition, 1992.
3. Ivan Tucker, Michael Nolan, Educational Audiology,U.S.A.; Croom Helm Limited, 1994.
4. StigArlinger, Manual of practical audiometry, Volume 2,Whurr, 1991.

COURSE OUTCOME

Student will be able to

1. Understand the basic principles of auditory system
2. Study about the speech and therapies
3. Understand how the diagnosis made with auditory defects
4. Understand the modalities of learning and teaching speech methods

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓							
CO3	✓	✓	✓		✓				
CO4	✓	✓		✓					

OE VIII	**SOFT COMPUTING TECHNIQUES**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

1. To teach a variety of contemporary approaches to neural networks a
2. To introduce th etheory underlying these approaches.
3. To study the biological and statistical foundations of neural networks and Fuzzy logic.

.

Introduction to Artificial Neural Networks and Biological Neuron: Fundamental concepts of –weights, biases and thresholds-linear separability-common activation functions-learning rules and learning methods of ANN-single layer feed forward network-multilayer feed forward network**.**

Neural Network Architectures and Algorithms: Mucullochpitts neuron-Hebb net-Perceptron-Back propagation neural net-Hopfield net-Hamming net–Kohonenself organizing maps-Adaptive resonance theory**.**

Applications of Neural Networks: Dynamic Back propagation for bio system identification and control -pattern recognitions -image processing -biological sequence alignment and drug design -robotics and sensors - information retrieval systems -natural language processing.

Fuzzy Sets: Basic definition– set-theoretic operations – membership functions – fuzzy rules and fuzzy reasoning – fuzzy relations –composition of fuzzy relations –fuzzy relation equations -arithmetic operations on fuzzy numbers -fuzzy inference systems – Mamdani fuzzy models – Sugeno fuzzy models – input space partitioning and fuzzy modelling.

Fuzzy Systems: Fuzzification methods - defuzzification methods- Fuzzy rule base- fuzzy logic controller- Mamdani and Sugeno type Fuzzy systems**.** Adaptive neurofuzzy inference systems- GA in adaptive fuzzy system.

REFERENCES:

1. LaureneFausett, Fundamentals of Neural Networks, Prentice- Hall, New Jersey, 3rd edition, 2008.
2. Timothy J. Ross, Fuzzy logic with Engineering applications, McGraw Hill, New York, 3rd edition, 2010.

3. Valluru.B.Rao, Hayagriva.Rao, Neural Networks & Fuzzy Logic, BPB Publications, New Delhi, 2003.
4. D.Driankov, H. Helleneloorn, M.Reinframe, An Introduction To Fuzzy Control, Narosa Publishing Co., New Delhi, 1996.
5. Jacek M. zurada, Introduction to Artificial Neural Systems,Jaico Publishing House, New Delhi, 1997.
6. Rajasekaran.S, VijayalakshmiPai.G.A, Neural Networks, Fuzzy logic and Genetic Algorithms, Prentice-Hall of India private limited, New Delhi,2003.

COURSE OUTCOME

Upon completion of this course student

1. Gains knowledge about various neural networks that can be used for biomedical signal analysis and Medical image analysis.
2. Can apply the concepts of ANN and Fuzzy Logic in Biomedical applications.
3. Will familiarize about the Self organizing maps and competitive networks
4. Research aspects can be formed to find solution for various organal abnormalities with these computing Techniques.

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓					✓		
CO2	✓	✓							✓
CO3	✓	✓	✓		✓			✓	
CO4	✓	✓		✓		✓			✓

OE IX	**BIO MEMS AND NANO TECHNOLOGY**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

To understand

1. Various MEMS fabrication techniques.
2. Different types of sensors and actuators and their principles of operation at the micro scale level.
3. Application of MEMS in different field of medicine.

MEMS and Microsystems: Typical MEMs and Microsystems - materials for MEMS - active substrate materials – siliconand its compounds -silicon piezoresistors - Gallium Arsenide – quartz - polymers.Micromachining– photolithography - thin film deposition – doping – etching - bulk machining -wafer bonding.

Microsensors and Acuators: Mechanics for MEMs design- static bending of thin plates - mechanical vibration –thermomechanics - fracture and thin film mechanics. Mechanical sensors and actuators – beam and cantilever – microplates - strain, pressure and flow measurements – gyroscope -piezoactuators. Thermal sensors and actuators- micromachined thermocouple probe –Peltier effect hat pumps - thermal flow sensors.

Micro Opto Electro Mechanical Systems (MOEMS): Fundamental principles - light modulators - light detectors - optical switch.Microfluidic Systems: Fluid dynamics - continuity equation, momentum equation, equation of motion -fluid flow in circular conduits –microconduits -submicrometer and nanoscale. Microscalefluid - expression for liquid flow in a channel -microfluid dispenser, microneedle, micropumps-continuous flow system.

Fundamentals of Nanoscience: Size dependence of properties - particle size determination - bulk to nano transition - semiconducting nanoparticles - carbon nanostructures –mechanical, optical and electrical properties of nanotubes. Preparation of Nanosystems: Introduction to nanolithography - carbon nanotubes -synthesis and preparation of nanomaterials (crystalline and thinfilm) - physical and chemical methods - control and stability (size, shape, composition).

Medical Applications: Nanotubes, nanowires, and nanodevices- functional nanostructures. Introduction to molecular electronics - field emission and shielding - molecular and supramolecular switches – biosensors – Qdots – Nanoshells – Nanobiotix – cancer detection – drug delivery using nanoparticles and molecular carriers.Nanoelectromechanical systems (NEMs) - CAD for MEMs -drug delivery - micro total analysis systems (MicroTAS) detection andmeasurement methods - microsystem approaches to polymerase chain reaction (PCR), DNA, hybridization.

REFERENCES:

1. Di Ventra, Massimiliano; Evoy, Stephane; Heflin, James R., Introduction to Nanoscale Science and Technology, Springer publications, 2004.
2. VinodLabhasetwar, Diandra L. Leslie-Pelecky, Biomedical Applications of Nanotechnology, Wiley–Interscience, A John Wiley & Son, Inc., Publication, 2007.
3. Chattopadhyay, Introduction to Nanoscience and Nanotechnology, PHI, 2009
4. Wanjun Wang, Stephen A.Soper,BioMEMs: Technologies and applications, CRCPress, New York, 2007.
5. NitaigourPremchandMahalik, MEMS, Tata McGraw Hill Publishing Company,New Delhi, 2007.

COURSE OUTCOME

Students will be able to

1. Understand the operation of different types of sensors and actuators at microscale level
2. Understand the design issues at microscale level
3. Choose the material for any application
4. Apply the concepts to the design of different types of micro systems

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓				✓		✓	✓
CO3	✓	✓	✓		✓		✓		
CO4	✓	✓		✓					✓

OE X	**MEDIEMBEDDED SYSTEMS AND RTOS**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

1. To impart knowledge medi embedded system and associated RTOS
2. To study about microcontrollers for medical systems

Overview of Embedded System: Features of Embedded System – categories – requirements- challenges and issues - applications of Embedded Systems in biomedical systems and health care systems. Software: Source code – object code and assembler using high level language– fetch and execute operation of CPU – instruction set–addressing modes – basic operation– microcontroller arithmetic and condition code register- program flow control using looping and branching.

Stack subroutines: stack to store data– subroutines– modular programming using subroutine and subroutine operation. Interrupts and Resets: Concepts of interrupts– interrupt vectors– interrupt operation- hardware interrupts and resets– software and CPU controlled interrupts.

Hardware: Bus– tri state logic- address encoding- different modes of operation– different memory technology (RAM EPROM, FLASH, CONFIG, and INIT). Serial sub system: Asynchronous communication system- serial communication interface- SCI registers– serial peripheral interface– SPI topologies and applications–SPI software and error handling.

Microchip PIC16 family: PIC16F873 processor – features – architecture – memory organization – register file map – I/O ports – Port A,B and C – Data EEPROM and flash program memory – Asynchronous serial port – SPI mode – I^2C mode. ARM family of microcontrollers: Introduction– ARM Arichitecture– Instruction formats–ARM derivatives– Programming with ARM Embedded Controllers – software tools for ARM – GNU 'C'- Keil – Peripheral interfacing - ARM applications – General features of ARM7, ARM9, ARM Cortex.

Embedded Real Time Software Design: Embedded operating system – comparison with general purpose OS – Real Time Operating System (RTOS) – tasks – kernel – RT scheduling – interrupt processing – memory management using RTOS – synchronization – message queues – control blocks – porting of RTOS to the target board – comparison and study of various RTOS like Windows CE, Embedded Linux, µcos, QNX, VXWORKS, Nucleus. Embedded system for biomedical applications: Hospital data base applications– Biosignal analysis– Hospital automation.

REFERENCES:

1. G.J. Lipovsk, Single and Multiple Chip Microcomputer Interfacing, Prentice Hall, 1988.
2. W.J. Tompkins & J.G. Webster, Interfacing Sensors to the IBM PC, Prentice Hall, Englewood Cliffs, NJ, 1988.
3. John B**.** Peatman**,** Design with PIC Microcontrollers**,** Prentice Hall, 1998.
4. David Seal, ARM Architecture Manual, Addison-Wesley,2nd edition, 2000.
5. Raj kamal, Embedded systems, Tata McGraw Hill, 2003.
6. Steve furber, ARM System on chip architecture, Pearson education2nd edition,

COURSE OUTCOME

Student will be able to

1. understand the concept of biocompatibility and the methods of biomaterial testing
2. Get awareness about the testing of the biomaterials done biologically before implantation in the human body.
3. Get knowledge about various interfacing devices.
4. Design a patentable embedded systems

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓					✓	✓	
CO3	✓	✓	✓		✓	✓			
CO4	✓	✓		✓					✓

OE XI	**MODELING OF PHYSIOLOGICAL SYSTEMS**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

1. To understand the fundamental engineering aspects of modelling Physiological systems
2. To utilize concepts derived from biomedical research to aid in the design of engineering systems.
3. To apply system techniques and methods to biomedical problems.

Biological control system: similarities and differences - components of living control system- Model and Analog- system properties- resistance- storage- distributed and lumped systems. Mathematical approach- electrical analogues. Approaches to modelling: Mathematical modelling - classification of models - characteristics of models. Purpose of physiological modeling and signal analysis - linearization of nonlinear models -model formulation – identification -validation and Simulation Different approaches of modeling physiological systems -linear modeling -distributed modeling -nonlinear modeling- time-varying modeling.

Nonparametric modeling: Volterra models - Wienermodels -efficient volterra kernel estimation -analysis of estimation errors. Parametric modeling: Basic parametric model forms -estimation procedures -Volterra kernels of nonlinear differential equations -discrete-time volterra kernels of NARMAX models -from Volterra kernel measurements to Parametric models -equivalence between continuous and Discrete -parametric models.Introduction to various process controls like cardiac rate - blood pressure - respiratory rate -blood - glucose regulation -pharmacokinetic modeling-compartmental models - blood-tissue models.

Equivalent circuit model: Electromotive, resistive and capacitive properties of cell membrane - change in membrane potential with distance - voltage clamp experiment - voltage dependent membrane constant and simulation of the model - model for strength-duration curve - model of the whole neuron - Huxley model of isotonic muscle contraction -modeling of EMG - motor unit firing - amplitude measurement - motor unit and frequency analysis.

Physiological modelling: Electrical analog of blood vessels - model of systematic blood flow - model of coronary circulation - transfer of solutes between physiological compartments by fluid flow - counter current model of urine formation - model of Henle's loop -linearized model of the immune response - Germ, Plasma cell, Antibody, system equation and stability criteria.

Electrical circuit model of oxygenation: A model of immune response to disease (Block Diagram) -modelling of multi input/multi output systems: The two-input case - Applications of two-input modelling to physiological systems - Multi-input case spatiotemporal and spectro temporal modelling. Respiratory system: Modeling oxygen uptake by RBC and pulmonary capillaries mass balancing by lungs - gas transport mechanism of lungs and O_2 and CO_2 transport in blood and tissues.
Case studies on modeling of physiological system:
Modeling of nerve action potential: Hodgkin-Huxley model.
Modeling of skeletal muscle contraction: Huxley Cross Bridge Model.
Modeling of myoelectrical activity.
Modeling of cardiovascular system: Block diagram representation of cardio vascular system,

REFERENCES:

1. David T. Westwick, Robert E. Kearney, Identification of Nonlinear Physiological Systems, Wiley-IEEE Press, 2003.
2. Michael C. K. Khoo, Physiological Control Systems -Analysis, simulation and estimation, Prentice Hall of India, 2001.
3. J. Enderle**, S.** Blanchard**,** J. Bronzino, Introduction to Biomedical Engineering**,** Academic Press, 3rd edition, 2012
4. Suresh.R.Devasahayam, Signals & Systems in Biomedical Engineering, Springer,2000.
5. V.Z. Marmarelis, Advanced methods of physiological system modeling, Springer,1999.
6. James V. Candy, Signal Processing: The Model Based approach,John Wiley sons, Newyork, 2006.
7. L.Stark, Neurological Control System, Plenum Press, New York, 1968.
8. R.B. Stein, Nerve and Muscle, Plenum Press, New York, 1980.

COURSE OUTCOME

Student will be able to

1. Acquire an insight into and understanding of the utilization of models, system analysis and analog simulation in the field of bioengineering.

2. Understand basic concepts of modeling for designing biological model.
3. Model and simulate physiological processes for better understanding
4. Use various simulation software for modeling biological systems.

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓				✓			
CO3	✓	✓	✓		✓		✓	✓	
CO4	✓	✓		✓					✓

OE XII	**NANOMEDICINE PRINCIPLES AND APPLICATIONS**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

1. To know basic nanotechnological principles and characterization methods

2. To understand the essential features of biology and nanotechnology that are converging to create the new areas of bionanotechnology and nanomedicine.

INTRODUCTION OF NANOPARTICLES: Overview of nanotechnology from medical perceptive, different types of nanobiomaterials and nanostructure interactions. Synthesis, characterization, and properties smart nanomaterials, Surface modification, biofunctionalization of nanomaterials.Nanocarriers (e.g. liposomes, polymer capsules, polymer nanoparticles, porous materials, nanogels, dendrimers, microemulsions, inorganic nanoparticles, carbon nanotubes, lipoproteins, solid lipid nanoparticles)

PROTEIN AS NANOSTRUCTURES: Protein based nanostructures building blocks and templates – Proteins as transducers and amplifiers – nanobioelectronic devices and polymer nanocontainers – microbial production of inorganic nanoparticles – magnetosomes.

DNA AS NANOSTRUCTURES: DNA based nanostructures – Topographic and Electrostatic properties of DNA – Hybrid conjugates of gold nanoparticles – DNA oligomers – use of DNA molecules in nanomechanics

NANOPARTICLES IN DIAGNOSIS: Introduction to nanoparticles in diagnostics— nuclear imaging, optical imaging, PET, Micro PET, cardio vascular disease studies,imaging and therapy of thrombosis,emerging Ethical issues and toxicology of nanomaterials

NANOTHERAPEUTICS: Nanoparticles as carriers in drug delivery- design, manufacture and physiochemical properties, transport across biological barriers, nanotechnology in Cancer therapy, lung infectious disease, bone treatment, nano particles for oral vaccination and skin disease.

REFERENCES:

1. Nanobiotechnology – Concepts, Applications and Perspectives – 2004. Edited by CM, Niemeyer, C.A. Mirkin. Wiley – VCH.
2. Nicholas A. Kotov, Nanoparticle Assemblies and Superstructures,CRC,2006.
3. T. Pradeep, Nano: The Essentials: McGraw – Hill, 2007.
4. Challa, S.S.R. Kumar, Josef Hormes, CarolaLeuschaer, Nanofabrication Towards Biomedical Applications, Techniques, Tools, Applications and Impact, Wiley – VCH,2005

COURSE OUTCOME

The student will be able to

1. Understand the concepts of Nano Medicine & its application in healthcare
2. Have knowledge on the technological developments in the field of Nano medicine.
3. Follow the newest findings in the area of Nano medicine andimplement the perspectives in own research.
4. Design and Develop models towards the targeted therapy.

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓				✓			
CO3	✓	✓	✓		✓				
CO4	✓	✓		✓			✓	✓	✓

OE XIII	**LASERS AND FIBER OPTICS IN MEDICINE**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

1. To understand the fundamentals in Laser and Fiber Optics.
2. To understand the applications of Laser and Fiber optics in health sector.

Introduction to Fiber Optics: Basic fiber link – applications - principles of light. EM spectrum, light as a wave, particle - speed of light - internal and external reflections - Snell's law -optical fiber numerical aperture - Fresnel reflection -optical fiber and its properties – construction - propagation of light - modes of operation - refractive index – types – dispersion - data rate - bandwidth - attenuation - losses.

Optical Sources and Detectors: Introduction - creation of photons – LED – ILD. Photo detectors: Introduction - PIN photodiode - avalanche photodiode - photodiode parameters - detector noise - speed of response and SNR.Modulation scheme for fiber optic transmission: Introduction - digital modulation -analog modulation schemes and multiplexing -applications of fiber optics in medical field.

Laser Systems: Introduction - types of Lasers - Laser characteristics: Single frequency operation - coherence of laser - spatial distribution - intensity of laser emission - polarization of laser emission - measurement of pulsed laser energy -principles of laser applications in medicine and biology.

Laser in biology: Optical properties of tissue -pathology of laser reaction in skin, thermal effects - laser irradiation -non thermal reactions of laser energy in tissue - effect of adjuvant.

Lasers in surgery: Surgical instrumentation of CO_2, Ruby, Nd-YAG, He-Ne, Argon ion, Q-switched operations - continuous wave, Quasi – continuous - surgical applications of these lasers. Laser applications: Lasers in dermatology – ophthalmology – photocoagulations – dentistry –cytometry -transillumination and diaphanography - speckle intereferometry, holography - application safety with biomedical Lasers.

REFERENCES

1. Leon Goldman, The Biomedical LASER Technology and Clinical Applications, Springer-Verlag, 1981.
2. Leon Goldman, Lasers in Medicine and Surgery, Springer-Verlag, 1982.
3. Pratesi E.D.R, and Sacchi, Lasers in Photomedicine and photo Biology, Springer-Verlag.
4. BashtM.L.Wel, Laser applications in medicine and biology, Vol I,II,III, Plenum Press 1974.
5. Nandini K. Jog, Electronics in medicine and biomedical instrumentation, Prentice-Hall of India Pvt. Ltd., 2006.

COURSE OUTCOME

Student will be able to

1. Understand the fundamentals and clinical applications of Laser and Fiber Optics.
2. Correlate the knowledge of medicine and engineering for the wellness of human being.
3. Understand the safety aspects while dealing with Laser and Fiber Optic Units.
4. Understand the modalities of treatments and research problems can be formed.

Mapping of COs with Pos									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓					✓		✓
CO3	✓	✓	✓		✓	✓		✓	
CO4	✓	✓		✓					