203200101 - Research Methodology & IPR

Course	Master of Technology (MTech)	**Semester - 1**
Type of Course	-	
Prerequisite	Knowledge of Electronics and Communication Systems and Technologies. Basic Computer Skills Fundamental Knowledge of Area of Interest in relevant discipline.	
Course Objective	The objective of the course is intended to develop the research skills in a systematic manner which will impart the ability to select appropriate research methodology, experimental design, follow professional ethics and academic integrity, and develop oral and written presentation skills.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
Lecture	Tutorial	Lab	Credit	T	T	P	P	
2	0	0	2.00	60	20	-	-	100

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Unit 1** Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.	5	20
2	**Unit 2** Effective literature studies approaches, analysis Plagiarism, Research ethics,	5	15
3	**Unit 3** Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.	5	15
4	**Unit 4** Nature of Intellectual Property: Patents, Designs, Trademarks and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	5	20
5	**Unit 5** Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.	5	15
6	**Unit 6**	5	15

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
	New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.		
	Total	**30**	**100**

Reference Books

1.	**Intellectual Property Rights Under WTO** T. Ramappa; S. Chand, 2008
2.	**Research methodology: an introduction for science & engineering students** Stuart Melville and Wayne Goddard; Juta & Co Ltd
3.	**Research Methodology: An Introduction** Wayne Goddard, Stuart Melville; Juta and Company Ltd, 2004
4.	**Research Methodology : A Step by Step Guide for Beginners** Ranjit Kumar; PEARSON; 3rd
5.	**Resisting Intellectual Property** Halbert; Taylor & Francis Ltd., 2007
6.	**Industrial Design** Mayall; McGraw Hill, 1992
7.	**Product Design** Niebel; McGraw Hill, 1974
8.	**Introduction to Design** Asimov; Prentice Hall, 1962
9.	**Intellectual Property in New Technological Age** Robert P. Merges, Peter S. Menell, and Mark A. Lemley; 2016

Course Outcome

After Learning the Course the students shall be able to:

At the end of this course, students will be able to
1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

203200102 - English for Research Paper Writing

Course	Master of Technology (MTech)	**Semester - 1**
Type of Course	-	
Prerequisite	Basic Knowledge about sentence formation using different words in present, past tenses and future time. Also, basic knowledge on use of suitable nouns, adjectives, verbs, preposition, etc.	
Course Objective	To provide a better insight for the effective use of grammar knowledge especially in writing and to put their own thoughts in to writing	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
Lecture	Tutorial	Lab	Credit	T	T	P	P	
2	0	0	0.00	60	20	-	-	100

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Unit 1** Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.	5	16
2	**Unit 2** Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts., Introduction	5	17
3	**Unit 3** Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	5	17
4	**Unit 4** Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.	5	17
5	**Unit 5** Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.	5	16
6	**Unit 6** Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.	5	16
	Total	30	99

Reference Books	
1.	**Writing for Science** Goldbort R; Springer
2.	**How to Write and Publish a Scientific Paper** Day R; Cambridge University Press
3.	**Handbook of Writing for the Mathematical Sciences** Highman N; SIAM. Highman's book
4.	**English for Writing Research Papers** Adrian Wallwork; Springer New York Dordrecht Heidelberg London,; 2011

203200103 - Disaster Management

Course	Master of Technology (MTech)	**Semester - 1**
Type of Course	-	
Prerequisite	Basics related to the disaster.	
Course Objective	To prepare for a leadership role in disaster management or the humanitarian field with in depth knowledge of resilience and risk reduction.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
2	0	0	0.00	60	20	-	-	100

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Introduction** Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.	5	17
2	**Repercussions Of Disasters And Hazards:** Economic Damage, Loss OfHuman And Animal Life, Destruction Of Ecosystem, Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.	5	17
3	**Disaster Prone Areas In India:** Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics.	5	17
4	**Disaster Preparedness And Management** Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.	5	17
5	**Risk Assessment** Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's, Participation In Risk Assessment. Strategies for Survival.	5	16
6	**Disaster Mitigation** Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.	5	16
	Total	30	100

Reference Books

1.	**Disaster Management in India: Perspect ives, issues and strategies** R. Nishith, Singh AK; 'New Royal book Company.
2.	**Disaster Mitigation Experiences And Reflections** Sahni, Pardeep Et.Al. (Eds.); Prentice Hall Of India, New Delhi.
3.	**Disaster Administration And Management Text And Case Studies** Goel S. L.,; Deep &Deep Publication Pvt. Ltd., New Delhi.

Course Outcome

After Learning the Course the students shall be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response

2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives

3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

203200104 - Sanskrit for Technical Knowledge

Course	Master of Technology (MTech)	**Semester - 1**
Type of Course	-	
Prerequisite	-	
Course Objective	To learn Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power and also will help scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
2	0	0	0.00	60	20	-	-	100

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Unit 1** • Alphabets in Sanskrit • Past/Present/Future Tense • Simple Sentences	10	33
2	**Unit 2** • Order • Introduction of roots • Technical information about Sanskrit Literature	10	33
3	**Unit 3** • Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics	10	34
	Total	30	100

Reference Books

1.	**Abhyaspustakam** Dr.Vishwas; Samskrita-Bharti Publication, New Delhi
2.	**Teach Yourself Sanskrit** Prathama Deeksha-Vempati Kutumbshastri; Rashtriya Sanskrit Sansthanam, New Delhi Publication
3.	**India's Glorious Scientific Tradition** Suresh Soni; Ocean books (P) Ltd., New Delhi

Course Outcome

After Learning the Course the students shall be able to:

1. Understanding basic Sanskrit language

2. Ancient Sanskrit literature about science & technology can be understood

3. Being a logical language will help to develop logic in students

203200105 - Value Education

Course	Master of Technology (MTech)	**Semester - 1**
Type of Course	-	
Prerequisite	-	
Course Objective	This course prepares the students to understand value of education and self- development, Imbibe good values in students and Let the should know about the importance of character.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
2	0	0	0.00	60	20	-	-	100

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Unit 1** • Values and self-development: Social values and individual attitudes. Work ethics, Indian vision of humanism. • Moral and non- moral valuation. Standards and principles. • Value judgments	6	20
2	**Unit 2** • Importance of cultivation of values. • Sense of duty. Devotion, Self-reliance. Confidence, • Concentration. Truthfulness, Cleanliness. • Honesty, Humanity. Power of faith, National Unity. • Patriotism.Love for nature, Discipline	8	27
3	**Unit 3** • Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. • Punctuality, Love and Kindness. • Avoid fault Thinking. • Free from anger, Dignity of labour. • Universal brotherhood and religious tolerance. • True friendship. • Happiness Vs suffering, love for truth. • Aware of self-destructive habits. • Association and Cooperation. • Doing best for saving nature	8	27
4	**Unit 4** • Character and Competence Holy books vs Blind faith. • Self-management and Good health. • Science of reincarnation. • Equality, Nonviolence, Humility, Role of Women. • All religions and same message. • Mind your Mind, Self-control. • Honesty, Studying effectively	8	27
	Total	30	101

Reference Books

1.	**Values and Ethics for organizations Theory and practice** Chakroborty, S.K.; Oxford University Press, New Delhi, 1999

Course Outcome

After Learning the Course the students shall be able to:

After Learning the course the students shall be able to:
1. Knowledge of self-development
2. Learn the importance of Human values
3.Develop the overall personality

203200151 - Constitution of India

Course	Master of Technology (MTech)	**Semester - 2**
Type of Course	-	
Prerequisite	-	
Course Objective	-	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		
Lecture	Tutorial	Lab	Credit	T	T	P	P	Total Marks
-	2	-	0.00	-	-	-	40	100

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

203200152 - Pedagogy Studies

Course	Master of Technology (MTech)	**Semester - 2**
Type of Course	-	
Prerequisite	-	
Course Objective	-	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
-	2	-	0.00	-	-	-	40	100

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Unit-1: Introduction and Methodology** Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education Conceptual framework, Research questions Overview of methodology and Searching	4	25
2	**Unit-2: Thematic overview** Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries Curriculum, Teacher education.	2	13
3	**Unit-3: Evidence on the effectiveness of pedagogical practices Methodology for the in depth stage** Quality assessment of included studies. How can teacher education (curriculum and practicum) andthe school curriculum and guidance materials best support effective pedagogy? Theory of change, Strength and nature of the body of evidence for effective pedagogical practices Pedagogic theory and pedagogical approaches, Teachers' attitudes and beliefs and Pedagogic strategies	4	25
4	**Unit-4: Professional development** Alignment with classroom practices and follow-up support, Peer support Support from the head teacher and the community Curriculum and assessment Barriers to learning: limited resources and large class sizes	4	25
5	**Unit-5: Research Gaps**	2	12

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
	Research gaps andfuture directions, Research design, Contexts Pedagogy, Teacher education,Curriculum and assessment, Dissemination and research impact.		
	Total	**16**	**100**

203200153 - Stress Management by Yoga

Course	Master of Technology (MTech)	**Semester - 2**
Type of Course	-	
Prerequisite	Knowledge of Sanskrit & different languages to learn from different holy books	
Course Objective	Students will be able to manage the stress.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
-	2	-	0.00	-	-	-	40	100

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Unit 1** Definitions of Eight parts of yog. (Ashtanga)	8	33
2	**Unit 2** Yam and Niyam. Do`s and Donts in life. i) Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan	8	34
3	**unit 3** Asan and Pranayam i) Various yog poses and their benefits for mind & body ii)Regularization of breathing techniques and its effects-Types of pranayam	8	33
	Total	24	100

Reference Books

1.	**Yogic Asanas for Group Tarining-Part-I** Janardan Swami; Yogabhyasi Mandal, Nagpur
2.	**Raja-Yoga; Or, Conquering the Internal Nature** Swami Vivekananda

Course Outcome
After Learning the Course the students shall be able to:
1. Develop healthy mind in a healthy body thus improving social health 2. Improve efficiency

203200154 - Personality Development through Life Enlightenment Skills

Course	Master of Technology (MTech)	**Semester - 2**
Type of Course	-	
Prerequisite	-	
Course Objective	The course provides details of personality development using study of Srimad Bhagavad Gita.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		
Lecture	**Tutorial**	**Lab**	**Credit**	**T**	**T**	**P**	**P**	**Total Marks**
-	2	-	0.00	-	-	-	40	100

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Unit 1** Neetisatakam-Holistic development of personality Verses- 19,20,21,22 (wisdom) Verses- 29,31,32 (pride & heroism) Verses- 26,28,63,65 (virtue) Verses- 52,53,59 (donts) Verses- 71,73,75,78 (dos)	8	33
2	**Unit 2** Approach to day to day work and duties. Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48, Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35, Chapter 18-Verses 45, 46, 48.	8	34
3	**Unit 3** Statements of basic knowledge. Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38,39 Chapter18 Verses 37,38,63	8	33
	Total	**24**	**100**

Reference Books	
1.	**Srimad Bhagavad Gita** Swarupananda, Swami; Advaita Ashrama
2.	**Bhartrihari's Three Satakam (Niti-sringar-vairagya)** P.Gopinath, Rashtriya Sanskrit Sansthanam; Rashtria Sanskrit Sansthan

Course Outcome

After Learning the Course the students shall be able to:
1. Develop his personality and achieve the highest goal in life with study of Shrimad-Bhagwad-Geeta. 2. Lead the nation and mankind to peace and prosperity after studying Geeta. 3. Develop versatile personality with the study of Neetishatakam.

203200201 - Business Analytics

Course	Master of Technology (MTech)	**Semester - 3**
Type of Course	-	
Prerequisite	-	
Course Objective	-	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
3	0	0	3.00	60	20	-	-	100

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Unit 1:** Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modeling, sampling and estimation methods overview.	9	15
2	**Unit 2:** Trendiness and Regression Analysis: Modeling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.	8	15
3	**Unit 3:** Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modeling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modeling, nonlinear Optimization.	9	20
4	**Unit 4:** Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.	10	20
5	**Unit 5:**	10	20

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
	Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.		
6	**Unit 6:** Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.	4	10
	Total	50	100

203200202 - Industrial Safety

Course	Master of Technology (MTech)	**Semester - 3**
Type of Course	-	
Prerequisite	Knowledge of basics of engineering.	
Course Objective	The course will impart the Industrial safety, Maintenance Engineering, Fault Tracing.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
3	0	0	3.00	60	20	-	-	100

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Industrial safety** Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.	8	17
2	**Fundamentals of maintenance engineering:** Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment	8	17
3	**Wear and Corrosion and their prevention:** Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.	9	20
4	**Fault tracing:** Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.	9	20
5	**Periodic and preventive maintenance:**	11	22

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
	Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance		
	Total	**45**	**96**

Reference Books

1.	**Maintenance Engineering Handbook** Higgins & Morrow; Da Information Services.
2.	**Maintenance Engineering** H.P.Garg; S. Chand and Company
3.	**Pump-hydraulic Compressors** Audels; Mcgrew Hill Publication.
4.	**Foundation Engineering Handbook** Winterkorn, Hans; Chapman & Hall London.

Course Outcome

After Learning the Course the students shall be able to:
1. Understand the industrial laws, regulations and source models. 2. Apply the methods of prevention of fire and explosions. 3. accomplish standard safety procedures in an industrial environment. 4. Understand the methods of hazard identification and preventive measures.

203200203 - Operation Research

Course	Master of Technology (MTech)	**Semester - 3**
Type of Course	-	
Prerequisite	-	
Course Objective	-	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		
Lecture	Tutorial	Lab	Credit	T	T	P	P	Total Marks
3	0	0	3.00	60	20	-	-	100

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Unit 1:** Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models	8	18
2	**Unit 2** Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming	8	20
3	**Unit 3:** Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT	8	22
4	**Unit 4** Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.	9	20
5	**Unit 5** Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation	10	20
	Total	43	100

Reference Books

1.	**Operations Research** Hamdy Taha; Pearson
2.	**Principles of Operations Research:** Harvey M Wagner; Prentice Hall of India, 2010
3.	**Introduction to Optimisation: Operations Research** J.C. Pant,; Jain Brothers
4.	**Operations Research** Hitler Libermann; McGraw Hill, 2009
5.	**Operations Research:** Pannerselvam; Prentice Hall of India, 2010

Course Outcome

After Learning the Course the students shall be able to:
Students should able to apply the dynamic programming to solve problems of discreet and continuous variables. 2. Students should able to apply the concept of non-linear programming 3. Students should able to carry out sensitivity analysis 4. Student should able to model the real world problem and simulate it.

203200204 - Cost Management of Engineering Projects

Course	Master of Technology (MTech)	**Semester - 3**
Type of Course	-	
Prerequisite	Basic civil engineering knowledge.	
Course Objective	Project planning management and economics,cost concepts.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
3	0	0	3.00	60	20	-	-	100

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Introduction** Introduction and overview of stratigic cost management process	4	10
2	**Cost Concepts** Cost concepts in decision making; Relevant cost, Diffrential cost, Incremental Cost, Opportunity cost, Objectives of costing system; Inventory valuation, Creation of database for operational control, Provision of data for decision making.	4	18
3	**Project** Project: meaning,Different types, why to manage,cost overruns centers,various stages of project execution:conceptionocommissioning. Project execut on as conglomerat on of technicaland nontechnical activities. Detailed Engineering activit es.Pre project execution main clearances anddocuments Project team: Role of each member.Importance Project site: Data required withsigniftcance. Project contracts. Types and contents.Project execution Project cost control.Bar chartsand Network diagram. Project commissioning: mechanical and process	13	26
4	**Cost Behavior and Profit Planning** Cost Behavior and Profit Planning Marginal Costing: Distinction between MarginalCosting andAbsorption Costing; Break-even nalysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costi ng and Variance Analysis. Pricing strategies: Pareto Analysis. Targetcosting, Life Cycle Costing. Costing of service sector. Just-in-time approach,Material RequirementPlanning, Enterprise Resource Planning, TotalQuality Management and Theory of constraints.Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-ChainAnalysis.Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets. Measurement ofDivisional profitability pricing decisions including transfer pricing.	13	26
5	**Quantitative techniques**	10	20

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
	Quantitative techniques for cost management,Linear Programming, PERT/CPM,Transportation problems.Assignment problems, Simulation, Learning Curve Theorv.		
		Total	**44**	**100**

Reference Books

1.	**Cost accounting a managerial Emphasis** Prentice Hall of India
2.	**Advanced Management Accounting** Charles T Horngren and George Foster
3.	**Management and Cost Accounting Model Curriculum of Engineering and technology PG Courses[Vol II]**
4.	**Principles and Practices of Cost Accounting** Ashish K Bhattacharya
5.	**Quantitative Techniques in Management by N D Vohra, Tata McGraw-Hill**

Course Outcome

After Learning the Course the students shall be able to:
After learning the course students shall be able to: 1. Understand principles of Strategic cost management 2. Understand principles of cost concepts. 3. Understand principles of cost behavior and Profit planning 4. Understand principles of quantitative techniques for cost management

203200205 - Composite Materials

Course	Master of Technology (MTech)	**Semester - 3**
Type of Course	-	
Prerequisite	Fundamental Knowledge of Solid Mechanics.	
Course Objective	Composite materials are extensively used in the aviation & automobile industries for the manufacturing of various parts. Composites are known to have a high strength to weight ratio and they, therefore, become the material of choice for aircraft manufacturing. There are several other benefits of using composite materials. This subject offers the knowledge and understanding of the engineering behavior of composite materials, preliminary design concepts and their appropriate use.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		
Lecture	Tutorial	Lab	Credit	T	T	P	P	Total Marks
3	0	0	3.00	60	20	-	-	100

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Introduction** Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.	7	15
2	**Reinforcements** Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.	10	25
3	**Manufacturing of Metal Matrix Composites** Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.	10	20
4	**Manufacturing of Polymer Matrix Composites** Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.	10	20
5	**Strength of Composites** Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.	8	20
	Total	45	100

203200206 - Waste to Energy

Course	Master of Technology (MTech)	**Semester - 3**
Type of Course	-	
Prerequisite	Knowledge of Renewable Energy Sources.	
Course Objective	This course provides knowledge of utilization of the energy from waste and conversion of waste into Bio gas.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		
Lecture	Tutorial	Lab	Credit	T	T	P	P	Total Marks
3	0	0	3.00	60	20	-	-	100

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Introduction to Energy from Waste** Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors	4	10
2	**Biomass Pyrolysis** Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods – Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.	7	15
3	**Biomass Gasification** Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.	9	20
4	**Biomass Combustion** Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.	8	20
5	**Biogas** Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion – Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.	17	35
	Total	45	100

Reference Books	
1.	**Non Conventional Energy (TextBook)** Desai, Ashok V.; Wiley Eastern Ltd.
2.	**Biogas Technology - A Practical Hand Book** Khandelwal, K. C. and Mahdi, S. S.; Tata McGraw Hill Publishing Co. Ltd., 1983
3.	**Food, Feed and Fuel from Biomass (TextBook)** Challal, D. S.; IBH Publishing Co. Pvt. Ltd., 1991
4.	**Biomass Conversion and Technology (TextBook)** C. Y. WereKo-Brobby and E. B. Hagan; John Wiley & Sons, 1996

Course Outcome
After Learning the Course the students shall be able to:
1. Make students aware about all the waste available and the ways to turn it into energy. 2. Utilize the bio mass energy in problem solving where conventional energy are not fruitful and require replacement. 3. Describe procedural approach for the biomass derived fuel system.

203231101 - Biostatistics

Course	Master of Technology (MTech)	**Semester - 1**
Type of Course	-	
Prerequisite	Calculus, Linear algebra, Probability theory	
Course Objective	To explain various statistics techniques for design of biological experiments, especially in medicine, pharmacy; the collection, summarization, and analysis of data from those experiments; and the interpretation of, and inference from, the results.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		
Lecture	Tutorial	Lab	Credit	T	T	P	P	Total Marks
3	1	0	4.00	60	20	-	-	100

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Introduction to Biostatistics** Introduction, Some basic concepts, Measurement and Measurement Scales, Sampling and Statistical Inference, The Scientific Method and the Design of Experiments, Computers and Biostatistical Analysis	6	15
2	**Descriptive Statistics** Introduction, The Ordered Array, Grouped Data: The Frequency Distribution, Descriptive Statistics: Measures of Central Tendency, Descriptive Statistics: Measures of Dispersion	9	20
3	**Probability** Definition of Probability, Law of Probability, Conditional Probability, Discrete Probability Distributions, Radom Variables, Continuous Probability Distributions, Standard Normal Distribution, Case Study.	12	25
4	**Estimation** Overview of Estimation, Estimation of the Mean of a Distribution, Variance of a Distribution, Binomial Distribution, Poisson Distribution, Case Study.	9	20
5	**Hypothesis Testing & Regression Methods** Hypothesis Testing: A Single Population Mean, Difference between Two Population Mean, A Single Population Proportion, Difference Between Two Population Proportions, A Single Population Variance, The Ratio of Two Population Variances, The Type II Error and the Power of a Test. Overview of Regression and Correlation Methods, Fitting Regression Lines, Simple Linear Regression, Partial and Multiple Correlation	9	20
	Total	45	100

Reference Books

1.	**Fundamentals of Biostatistics** Sarmakaddam; Jaypee Brothers Medical Publishers (P) Ltd
2.	**Introduction to Statistics for Biomedical Engineers** Kristina M. Ropella
3.	**A foundation for analysis in the health sciences** Wayne S. Daniel, Biostatistics; John Wiley & Son; 6
4.	**Primer of biostatistics** Stanton A. Glantz; Mc Graw Hill; 2

Course Outcome

After Learning the Course the students shall be able to:

1. Understand basic concepts, ideas, and techniques often used in statistics, especially biostatistics;
2. Develop appreciation of (i) variation, (ii) importance of design to the overall quality of a study, (iii) impact of assumptions on data analysis and interpretation, and (iv) artifacts and caveats in data analysis and interpretation;
3. Carry out simple exploratory/graphical/formal/diagnostic analysis; and Know when and where to seek statisticians' help.
4. To understand concepts and interpretation of statistical results

203231102 - Advanced Biomedical Signal Processing

Course	Master of Technology (MTech)	**Semester - 1**
Type of Course	-	
Prerequisite	Fundamentals of signal processing	
Course Objective	The course aims at providing the students with the knowledge and methodology for extracting useful information, implement the advanced signal processing and pattern classification techniques on different biomedical signals like ECG, EEG, and EMG and from that interpret the results and validate the descriptors obtained in the light of knowledge of the biological system involved.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		
Lecture	Tutorial	Lab	Credit	T	T	P	P	Total Marks
3	0	2	4.00	60	20	30	20	150

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Signal Conversion** Sampling basics, simple signal conversion system, conversion requirements for biomedical signals, signal conversion circuits.	5	10
2	**Basics of Digital Filtering** Digital filters, Z transform, Elements of digital filters, types of digital filters, Transfer function of a differential equation, Z-plane pole zero plots, The rubber membrane concept	7	15
3	**Finite & Infinite Impulse Response Filters** Filters Characteristics, Smoothing Filters, Notch Filters, Derivatives, window design, Frequency sampling minimax design. Infinite impulse Response filters: Generic equation of IIR filters, simple one pole example, Integrator, Design method of two pole filters, IIR Digital filter for ECG Analysis.	10	25
4	**Integer & Adaptive Filters** Basic Design Concept, LP, HP BP and Band reject filters, The effects of filter cascades, Adaptive filters: Principle of noise canceler model, 60 Hz adaptive canceling using a since wave model, other applications of adaptive filtering.	8	20
5	**Signal Averaging** Basics of Signal Averaging, Signal averaging as a digital filter, a typical averager, software for signal averaging, limitations of signal averaging.	5	10
6	**Data Reduction Techniques** Turning point algorithm, AXEC algorithm, CORTES, Fan algorithm, Huffman algorithm.	5	10
7	**ECG QRS Detection and Analysis System**	5	10

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
	Bandpass filtering Techniques, Differentiation techniques, Template matching techniques, QRS detection algorithm. ECG interpretation, ST segment analyzer, portable arrhythmia Monitor.		
	Total	**45**	**100**

Reference Books

1.	**Discrete-Time Signal Processing** Alan V. Oppenheim; PHI; 2
2.	**Biomedical Signal processing** J. A. Tompkins and J. A. White; PHI
3.	**Biomedical Signal Analysis, A Case Study Approach** Rangaraj M. Rangayyan
4.	**Digital Signal Processing: Principles, Algorithms and Applications** John G. Proakis Dimitris K Manolakis; PHI; 3

List of Practical

1.	To Study about the DFT Algorithm.
2.	To Study about the Rubber Membrane Concept.
3.	To Study about the FIR Filter.
4.	To Study about the IIR Filter.
5.	To Study about Butterworth Filter.
6.	To study about the Smoothing Filter using various techniques.
7.	To study about QRS event detection of ECG signal using various methods.
8.	Write a MATLAB Code to Design Low Pass Filter using Transfer Function.
9.	Write a MATLAB Code to Design High Pass Filter using Transfer Function.
10.	Write a MATLAB Code to Design Notch Pass Filter using Transfer Function.

Course Outcome

After Learning the Course the students shall be able to:

1. To understand human physiological system and acquisition of various Biomedical signals.
2. To understand basic and advanced digital filtering for biomedical signals.
3. Students can able to design analog and digital IIR and FIR filters for various biomedical Applications.
4. To implement advanced signal processing and classification techniques for biomedical signals to Diagnose various diseases.

203231130 - Advance Biomaterials

Course	Master of Technology (MTech)	**Semester - 1**
Type of Course	-	
Prerequisite	Fundamentals of Material science	
Course Objective	The course aims at providing the students with the knowledge of biomaterials, classification (metals, polymers, and ceramics, bioresorbable and biodegradable materials), different properties on materials used in medicine.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		
Lecture	Tutorial	Lab	Credit	T	T	P	P	Total Marks
3	0	2	4.00	60	20	30	20	150

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Introduction** History of biomaterials, General Properties of Bio–materials, Classes of materials used in medicine.	5	10
2	**Properties of Materials** Properties of materials - Bulk and surface properties and their characterization. Mechanical Properties of Biomaterials. Classes of materials used in medicine - Metals, Polymers, Hydrogels Bioresorbable and Biodegradable Materials.	7	15
3	**Metallic and Ceramic biomaterials** Stainless steel, Titanium, Alloys, Cardiovascular Orthopaedic and Dental applications. Corrosion of Bio-metals - Types of Valve Prostheses - Cardiac Stent- Bio-Ceramics - Bio–inert ceramics, Bio–active ceramics, Biodegradable ceramics, Alumina, Zirconia, Hydroxyapatite.	10	25
4	**Polymeric Biomaterials** Types of polymers - Sterilization, Structure, Bio-compatibility relationship, Stability, Examples of polymers used in medicine - Hydrogels and drug delivery systems - Sutures, Adhesives, and Hydro colloids - Super absorbents - artificial skin and blood.	8	20
5	**Testing of Biomaterials** In- vitro and In- vivo assessment of tissue compatibility - Testing of blood-materials interactions -Degradation of materials in the biological environment; - Effects of the Biological environment on metals, polymers and ceramics.	5	10
6	**Host reactions to biomaterials** Inflammation - Wound healing and the Foreign body response - System toxicity and Hypersensitivity - Blood coagulation and Blood-material Interactions - Tumorigenesis, Implant associated infection.	5	10
7	**Standards for Biomaterials and Contemporary Issues**	5	10

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
	World standards - Indian Standards - Specifications - General specifications, Classification of Specifications.		
	Total	**45**	**100**

Reference Books

1.	**Materials: engineering, science, processing and design** Michael F. Ashby, Hugh Shercliff, David Cebon; Elsevier Ltd, Cambridge; 3
2.	**Biomaterials Science** Ratner, Hoffman, Schoen, Lemons; Academic Pres; 1
3.	**PEEK Biomaterials Handbook** Steven M. Kurtz; Elsevier, Atlanta; 1

List of Practical

1.	To study introduction of Biomaterials used in Medicine and their general Properties.
2.	To study about different types of biomaterials used in medical implants and describe their properties.
3.	To study about Sterilization of Biomaterials.
4.	To study about testing of biomaterials.
5.	To study about the application of Biomaterials.
6.	To study about special considerations for implants, devices and biomaterial.
7.	To study Nanomaterial applications in Medicine.
8.	To study BioMEMS Applications in Medicine.
9.	To study application of Biomaterials in Trauma, Cardiovascular and tissue scaffolds.
10.	To study about the standards for the Biomaterials.

Course Outcome

After Learning the Course the students shall be able to:

1. Comprehend the basic biomaterials concepts with different classes, properties and standards to be used in healthcare industry.
2. Ability to understand the various classification of biomaterials used in medicine, its bulk and surface properties and its wide applications.
3. Appreciate the specific properties of biopolymers (synthetic and natural) and ceramics used in healthcare applications.
4. Envision the different evaluation methods to analyse the biomaterials under in-vitro and in-vivo environment with its degradation properties.
5. Perceive the knowledge on host response to biomaterial, toxic effect and its interactions.
6. Ability to understand the significant applications of biomaterials used in contact with the human body.

203231131 - Networking and Information System in Medicine

Course	Master of Technology (MTech)	**Semester - 1**
Type of Course	-	
Prerequisite	Network theory, ISDN, PSTN	
Course Objective	This Course Is Offered To Introduce Fundamentals Of Data Communication And Principles Of Multimedia, To Discuss The Overview Of Available Networks For Telemedicine, To Express The Knowledge Of Tele Medical Standards, Mobile Telemedicine And Its Applications, To Develop The Basic Parts Of Tele Radiology Systems Like Image Acquisition System, Display System, Communication Network, Interpretation.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		
Lecture	**Tutorial**	**Lab**	**Credit**	**T**	**T**	**P**	**P**	**Total Marks**
3	0	2	4.00	60	20	30	20	150

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Introduction to Networking** Introduction, System Components, Networked Communities, Host Management, User Management- Application Level Services, Network Level Services, and Principles of Security, Security Implications, and Analytical System Administration.	7	15
2	**Communication Network and Services** Types of information: Audio, Video, Still Images, Text and data, and Fax - Types of Communication and Network: PSTN, POTS, ATN, and ISDN - Basic concepts of Communication and Network: Internet, and Wireless communications.	9	20
3	**Standards for Data Exchange** Real-time Telemedicine. Data Exchange: Network Configuration, circuit and packet switching, H.320 series (Video phone based ISBN) T.120, H.324 (Video phone based PSTN). Video Conferencing.	7	15
4	**Hospital Management** Need for HMIS, Capabilities & Development of HMIS, functional area, modules forming HMIS, (like Pathology Lab, Blood bank, Pharmacy, Diet planning).	9	20
5	**Hospital Information System** Maintenance and development of HMIS-Ideal Features and functionality of CPR, Development tools for CPR.	4	10
6	**Picture Archival Communication Systems (PACS)** Types of image formats, DICOM standard, PACS system: Block diagram, Storing & retrieving images, Algorithm for retrieving images, Compressions and its significance, Lossless data Storage and in-house communication, Computer aided diagnosis (CAD), Centralized Database.	9	20
	Total	45	100

Reference Books	
1.	**Computer Networks (TextBook)** Andrew Tanenbaum; Pearson Education; 5th Edition
2.	**Introduction to Biomems** Albert Folch; CRC Press; 1
3.	**Microfluidics and Biomems application** Francis E. H. Tay; Springer, Berlin; 1
4.	**Medical Informatics: An Executive primer** Kenneth R. Ong; HIMSS Publishing; 1
5.	**Telemedicine Technologies: Information Technologies in Medicine and Tele-health** Bernard Fong, A.C.M. Fong and C.K. Li,; Wiley- Blackwell, New Jersey; 1
6.	**MEMS & Microsystem, Design and manufacture** Tai-Ran Hsu; McGraw Hill, New York; 1
7.	**Web-based Application in Healthcare and Biomedicine** Lazakidu; Springer, New York.; 1

List of Practical	
1.	To study about Networking.
2.	To study about ISDN and PSTN.
3.	To study about POTS and ATN.
4.	To study about Network configuration.
5.	To study about HMIS system.
6.	To study about PACS.
7.	To study about CAD.
8.	To study about Development tools for CPR.
9.	To study about DICOM Standards.
10.	To study about Compression techniques.

Course Outcome
After Learning the Course the students shall be able to:
1. Comprehensive coverage to concepts of Telemedicine 2. To apply multimedia technologies telemedicine 3. Develop a protocols behind encryption techniques for secure data transmission 4. Students will acquire a basic knowledge about the hospital at home and remote diagnostics 5. Understand the often complex legal, regulatory and reimbursement in telemedicine 6. Able to identify and address the sociotechnical factors in telehealth

203231132 - MEMS & NEMS for Biomedical Applications

Course	Master of Technology (MTech)	**Semester - 1**
Type of Course	-	
Prerequisite	MEMS, NEMS	
Course Objective	This Course is offered to Introduce and discuss the historical background of evolution of MEMS and Microsystems, Comprehend various modern micromachining techniques and discuss scaling effects in miniaturizing devices, To Discuss and compare various tools and techniques to create microfluidic devices for various BioMEMS and Microfluidic applications.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		
Lecture	Tutorial	Lab	Credit	T	T	P	P	Total Marks
3	0	2	4.00	60	20	30	20	150

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Introduction to MEMS** What is MEMS? Historical Background- Smart materials and structures-Microsystems and their advantages-Materials used-Technology involved in MEMS.	6	10
2	**Micro Machining Technology** Lithography, etching, Ion implantation, Wafer bonding, Integrated processing- Bulk micro machining, Surface micro machining, Coating technology and CVD, LIGA process.	7	20
3	**Scaling** Scaling in Geometry-Scaling in Rigid, Body Dynamics, Scaling in Electrostatic Forces, Scaling in Electromagnetic Forces-Scaling in Electricity, Scaling in Fluid Mechanics, Scaling in Heat Transfer.	6	10
4	**Microfluidic System** General principles, Micro sensors, Pressure sensors, Actuators, Electrostatic forces, Piezoelectric crystals, Intelligent materials and structures - Important consideration on micro-scale fluid, Properties of fluid, Fluid actuation methods, Micro-pumps, Typical Micro-fluidic channel, Micro fluid dispenser.	8	20
5	**MEMS Application in Medicine (BioMEMS)** Special features / requirements for medical applications. Current scenario of MEMS for health care. Drug delivery systems and MEMS. Application models – Blood pressure sensors – Biochip –Micro needles-Microelectrodes- Neural prosthesis and catheter end sensors.	6	10
6	**Biomedical Nanotechnology** Nanotechnology and biomedicine- Medical applications of Nanotechnology- Drug synthesis and delivery-Nano-biomedicine and diagnostic.	6	10

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
7	**Nanofabrication Techniques** Nanofabrication methods – Nano materials in human body- Toxicity in nano-materials.	6	10
	Total	45	90

Reference Books

1.	**Introduction to Biomems** Albert Folch; CRC Press; 1
2.	**Microfluidics and Biomems application** Francis E. H. Tay; Springer, Berlin; 1
3.	**MEMS & Microsystem, Design and manufacture** Tai-Ran Hsu; McGraw Hill, New York; 1

List of Practical

1.	To study about Introduction of MEMS.
2.	To study about Lithography.
3.	To study about LIGA process.
4.	To study about Microfluidic System.
5.	To study about Applications of MEMS in Medicine.
6.	To study about the concept of Nanotechnology.
7.	To study about the Nanofabrication Techniques.
8.	To study about Drug synthesis and delivery.
9.	To study about Toxicity in Nano-materials.
10.	To study about Mechanism of Micro-pumps.

Course Outcome

After Learning the Course the students shall be able to:

1. Inception of historical background of evolution of MEMS and Microsystems to the students.
2. Comprehend the understanding of various modern micromachining techniques and device fabrication.
3. Hands-on exposure to scaling effects in different Physical domains on miniaturizing devices was done.
4. Exposure to various tools and techniques to create microfluidic devices for BioMEMS and Microfluidic applications.
5. Acquaintance with various applications of MEMS/NEMS in Bio- medical nanotechnology and Healthcare.
6. Incepted various Nanofabrication techniques to the students.
7. Design and simulation for developing various MEMS/NEMS device.

203231133 - Medical Instrumentation & Systems

Course	Master of Technology (MTech)	**Semester - 1**
Type of Course	-	
Prerequisite	Circuit analysis techniques with dependent sources, equivalence, Basic systems analysis concepts using Laplace techniques and Bode Plots, Transient and frequency response of 1st-order circuits	
Course Objective	This course is offered to aid postgraduate biomedical engineering students by helping them to understand the analog electronic circuits used in signal conditioning in biomedical instrumentation. Because many bioelectric signals are in the microvolt range, noise from electrodes, amplifiers, and the environment is often significant compared to the signal level. This course illustrates how op amps can be used to build instrumentation amplifiers, isolation amplifiers, active filters, and many other systems and subsystems used in biomedical instrumentation.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		
Lecture	**Tutorial**	**Lab**	**Credit**	**T**	**T**	**P**	**P**	**Total Marks**
3	0	2	4.00	60	20	30	20	150

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Operational Amplifier Fundamentals** Circuits With Resistive Feedback, Static Op Amp Limitations, Dynamic Op-Amp Limitations	7	15
2	**Active filters** The transfer function, first-order active filters, standard second-order responses, KRC filters, filter approximations, cascade design, generalized impedance converters, the switched capacitor, the switched-capacitor filters.	8	20
3	**Instrumentation and Medical Isolation Amplifiers** Instrumentation Amps, Medical Isolation Amps, Safety Standards in Medical Electronic Amplifiers, Medical-Grade Power Supplies, Electrical safety issues in medical devices.	7	15
4	**Noise and the Design of Low-Noise Amplifiers for Biomedical Applications** Noise Properties, Noise Dynamics, Sources of Noise, Noise Factor and Figure of Amplifiers, Noise in Differential Amplifiers, Effect of Feedback on Noise, Low-Noise Amplifiers, Low-Noise Signal Conditioning System Design	9	20
5	**Special Analog Circuits and Systems in Biomedical Instrumentation** The Phase-Sensitive Rectifier, Phase Detectors, Voltage and Current-Controlled Oscillators, Phase-Locked Loops, IC Thermometers, Voltage Comparators, Sample-and-Hold Circuits, V-F and F-V Converters, Voltage References and Regulators	9	20
6	**Digital Interfaces** Aliasing and the Sampling Theorem, Digital-to-Analog Converters (DACs), Hold Circuits, Analog-to-Digital Converters (ADCs)	5	10
	Total	45	100

Reference Books

1.	**Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation** Robert B. Northrop; CRC press; 2004
2.	**Design with Operational Amplifiers and Analog ICs** Sergio Franco; WCB/McGrawHill; 3
3.	**Design And Development of Medical Electronic Instrumentation** David Prutchi, Michael Norris; John Wiley & Sons, Inc. Publications; 2005

List of Practical

1.	Testing of static and dynamic limitations of op-amp.
2.	Design and testing of first order and second orders filters.
3.	Design and testing of Cascade filters.
4.	Design and testing of multiple-feedback filters.
5.	Design and testing of Instrumentation Amplifiers.
6.	Design and testing of Medical Isolation Amplifiers.
7.	Design and testing of Low-Noise Amplifiers.
8.	Design and testing of Voltage and Current-Controlled Oscillators.
9.	Design and testing of V-F and F-V Converters.
10.	Design and testing of ADC and DAC.

Course Outcome

After Learning the Course the students shall be able to:

1. To investigate a variety of resistive op amp circuits with emphasis on feedback principles.
2. To analyze and design active filters.
3. To investigate the effect of op amp non-idealities upon the DC as well as the AC and transient responses of popular op amp circuits.
4. To study the design of popular op amp and comparator applications in test, control, and instrumentation.

203231134 - Embedded Systems and IoT for Biomedical Applications

Course	Master of Technology (MTech)	**Semester - 1**
Type of Course	-	
Prerequisite	Networking Protocol, Micro-Controller	
Course Objective	This Course is offered to develop a comprehensive understanding of the technologies behind the embedded systems. It is also used to discover the programming concepts and embedded programming in linux, To discuss the overview of embedded networking and Introduce student to the Internet of things (IOT) with interfacing sensors, actuators for portable gadgets.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		
Lecture	Tutorial	Lab	Credit	T	T	P	P	Total Marks
3	0	2	4.00	60	20	30	20	150

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Introduction to Embedded Systems** Characteristics of embedded computing applications, concepts of real time systems, general purpose and customized processor, different architectures, caches, virtual memory. Embedded design life cycle – Tools used in Design Process – Challenges in Embedded system design for bio medical applications.	7	15
2	**Health care System design using general purpose processor** ARM instruction set, ,ARM Cortex MX architecture, bus, exception, floating point implementation, memory map, bit banding, peripherals, Programming the peripherals, ADC,DAC, GPIO, Timer, PWM, UART, SPI, I2C, Embedded health care monitoring systems (Temperature, BP, Blood Glucose, non-invasive pulse oximeter, ECG & panic alarm).	10	20
3	**Embedded Linux programming** Fundamentals of Linux, shell scripting, process and thread creation, semaphores, single board computers (Raspberry pi).	5	10
4	**Embedded Networking** UART, I2C, WIFI, Bluetooth, Zigbee, Ethernet, Infrastructures for networking , LAN, Routers, Switches, hub, WLAN, Access Points, Hubs, Linux Network configuration Concepts: Networking configurations in Linux Accessing Hardware & Device Files interactions, IP and MAC addressing.	11	20
5	**IoT Architecture and platforms** History of IoT, M2M communication, Web of Things, IoT protocols, IOT reference layer, IoT Communication Pattern, IoT protocol Architecture,6LoWPAN, Security aspects in IoT, Hardware platforms- ARM Cortex Processors, TI CC3200 Launch pad, Intel Galileo boards, fast prototyping using Proteus, Single board computers(SBC), Aurdino.	7	15
6	**Sensors with Cloud and Internet connectivity** Streaming sensor data to Internet, Control of IO ports on Sensor hardware from Internet, Headless systems programming and configuring, Working with MAC Addresses, Cloud Dashboards and Monitoring.	5	10

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
7	**IoT in Biomedical Applications** IoT client and IoT gateway in healthcare, IoT driven smart health care application for everyday use, life critical applications, Health care IOT for rural area, Use of Big Data and Visualization in IoT, Industry4.0 concepts., sensor markup language.	5	10
	Total	50	100

Reference Books

1.	**The Internet of Things** Samuel Greengard; MIT press; 1
2.	**Learning Internet of Things** Peter Waher; Packt Publishing; 1
3.	**Internet of Things** Arshdeep Bahga, Vijay Madisetti; VPT publishing Inc; 1
4.	**Designing the Internet of Things** Adrian McEwen, Hakim Cassimall; Wiley; 1st

List of Practical

1.	Introduction to Keil Micro-Vision4.
2.	To study Basic Architecture of ARM7 lpc2129.
3.	To study GPIO Register of lpc2129 with example.
4.	Blinking the LED connected to the GPIO.
5.	Program to interface 16X2 LCD with lpc2129.
6.	To Study about Basic Architecture of Internet of Things.
7.	Demonstrations of Different IOT Devices.
8.	Introduction to Arduino board (Node mcu) and working of Raspberry Pi.
9.	Interfacing of ESP32 with Max30102 and Real time data visualization on webserver.
10.	Design and Development of Internet of Things live patient Monitoring system.

Course Outcome

After Learning the Course the students shall be able to:

1. To understand the architectural blocks in 32 bit microcontrollers
2. Ability to develop appreciation of the technology capabilities and limitations of the hardware, software components for building embedded systems.
3. Aware of fundamentals of programming concepts
4. Acquire basic knowledge about the system control to perform a specific task.
5. Understand the IoT application development.
6. Implement the IoT concept in biomedical applications.

203231135 - Biomedical Sensors and Data Acquisition Techniques

Course	Master of Technology (MTech)	**Semester - 1**
Type of Course	-	
Prerequisite	Sensors, Actuators, DAQ System	
Course Objective	This Course is offered to relate the principles of bio potential sensing and electrodes to biomedical applications, to identify the type of signal conditioning needed and the data acquisition cards for a specific sensor output, to acquaint the students with the communication standards and PC buses for data acquisition, to introduce virtual instrumentation and the hardware interfacing.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		
Lecture	Tutorial	Lab	Credit	T	T	P	P	Total Marks
3	0	2	4.00	60	20	30	20	150

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Bioelectrodes** Origin of bio potential and its propagation. Electrode-electrolyte interface, Electrode–skin interface, Half-cell potential, Impedance, Polarization effects of electrode – Non-polarizable electrodes. Types of electrodes - Surface, Needle and Micro electrodes and their equivalent circuits. Recording problems - Measurement with two electrodes.	5	10
2	**Physiological Transducers** Thermoresistive – Thermoelectric – Semiconductor - Piezoelectric sensors- Electrets in Capacitive transducers- Pyroelectric effect – Piezoresistive effect- strain gauges- Hall Effect-Magnetostrictive effect, SQUID – AC/DC bridges - Temperature compensation.	8	20
3	**Fundamentals of Bioelectric Signal Acquisition** Introduction to bioelectric signals- Configuration and structure- Interface systems- Review of quantization in amplitude and time axis.	5	10
4	**Bioamplifiers** Need for bio-amplifier - Single ended bio-amplifier, Differential bio-amplifier – Right leg driven ECG amplifier- Band-pass filtering, Isolation amplifiers – Transformer and optical isolation - Isolated DC amplifier and AC carrier amplifier. Chopper amplifier- Power line interference, Macroshock and Microshock, Preventive measures to reduce shock hazards.	8	20
5	**DAQ cards** Analog to digital conversion and Data acquisition cards- Analog and digital inputs, Counter timer I/O-accuracy and dynamic range, Speed vs throughput-Acquisition of general waveforms and biosignals- Issues in online monitoring- Web-based online monitoring.	8	20
6	**Interface Standards and PC Buses**	5	10

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
	RS232, RS422, RS485, GPIB, USB – Firewire - Backplane buses - PCI, PCI-Express, PXI, PXI Express, VME, VXI - Ethernet –TCP/IP protocols.		
7	**Virtual Instrumentation** Virtual instrument and traditional instrument, hardware and software-Building Graphical User interfaces for use in data acquisition- Graphical programming- Multi-channel data acquisition in LabVIEW.	5	10
	Total	44	100

Reference Books

1.	**Biomedical Instrumentation and Measurements** Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer; Prentice Hall, New Delhi; 2nd Edition
2.	**Medical Instrumentation Application and Design** J. G. Webster; John Wiley & Sons, N.Y
3.	**Introduction to Data Acquisition with LabVIEW** Robert H King; McGraw Hill, NewYork.; 2
4.	**Handbook of Biomedical Engineering, second edition –Volume II** Bronzino Joseph D.; CRC press,2010; 2010

List of Practical

1.	To study about Electrode-Electrolyte Interface.
2.	To study about various types of Physiological transducers.
3.	To study about bioelectric signal acquisition process.
4.	To study about Right Leg Drive ECG Amplifier.
5.	To study about DAQ card.
6.	To study about the Interface standards and PC buses.
7.	To study about Virtual Instrumentation.
8.	To study about Graphical User interfaces used in data acquisition.
9.	To study about PCI-Express.
10.	To study about PXI Express.

Course Outcome

After Learning the Course the students shall be able to:

1. Perceive the origin of bio signals and their measurement
2. Prescribe a sensor type to measure a specific physiological parameter.
3. Describe the different Bio signals and their characteristics
4. Design signal conditioning circuit for specific biomedical signal.
5. Select a type of interface and data acquisition system for the given biomedical signal.
6. Identify the communication protocol for the given bio signal.
7. Develop graphical user interface for biomedical signal acquisition and analysis.
8. Design a prototype of a medical device

203231151 - Seminar & Mini Project

Course	Master of Technology (MTech)	**Semester - 2**
Type of Course	-	
Prerequisite	Optimistic mind-set, Enthusiasm of learning new things, and unlearning yourself	
Course Objective	It is essential to upgrade knowledge of rapidly developing technology with practical and communication aspects. In planning this course, it was decided to develop practical skills as well as creativity and overall personality development by means of presentation and model preparation.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
0	0	4	2.00	-	-	50	50	100

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Outcome

After Learning the Course the students shall be able to:

1. Identify engineering problems reviewing available literature.
2. Study different techniques used to analyze complex systems.
3. Solve a live problem using software/analytical/computational tools and present solution by using technique and applying engineering principles.
4. Learn to write technical reports and develop skills to present and defend their work in front of a technically qualified audience.

203231152 - Healthcare Management

Course	Master of Technology (MTech)	**Semester - 2**
Type of Course	-	
Prerequisite	Administrative Knowledge	
Course Objective	The course aims at introduction to general management principles and basic healthcare application, to explore on International and national healthcare problems and issues, to discuss Planning, budgeting and uses of computers and information technology, to Explore International standards and protocol for hospital management	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		
Lecture	Tutorial	Lab	Credit	T	T	P	P	Total Marks
4	0	0	4.00	60	20	-	-	100

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Introduction** Principles of Management – Origin of principles of Management, Henry Fayol's 14 principles of Management, elements of management, organizational hierarchy, Introduction to principles of management in Healthcare environment, health ergonomics.	6	10
2	**Healthcare Service Providers** Role of the healthcare service providers Conventional hospital setup, types of leadership in healthcare environment, Private clinics, Corporate hospitals.	8	15
3	**Classification of Hospital Systems** General Hospital –Specialist Hospital –Teaching – Research, Primary Health Centre –Their role, Functions. Role of Biomedical Engineers, Aspects of Hospital Services-Outpatient- Inpatient supportive emergency, drug and medical supply, Nursing Services, Dietary services, Transport services.	14	25
4	**Hospital Planning** Orientation, Budgeting, Communication within the hospital and outside the hospitals - Electric power supply for various theatres and rooms, Diesel generator, Stand by power supply- Air conditioning of important theatres and equipment housings - Water supply requirements & management, Lifts and firefighting equipment's - Sanitation within the hospitals, Laundry services.	11	20
5	**Computer and Information Management in Hospital** Computer aided hospital management- Application, Administration/Discharge records of patients, Patient billing, Maintenance of patient records and their history - Maintenance of inventory of medicines and drugs – Purchase.	8	15
6	**Hospital Standards and Maintenance**	8	15

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
	Introduction to ISO - WHO standards, FDA standards, Indian standards for biomedical equipment services, Their purchase, Servicing and maintenance- Keeping intact and throwing the condemned equipment, Training personal for medical equipment, Preventive and periodical maintenance procedures.		
	Total	**55**	**100**

Reference Books

1.	**Management Principles for Health Professionals** Joan Gratto Liebler, Charles R. McConnell; Jones and Bartlett Learning, Massachusetts; 6
2.	**Introduction to Health Care Management** Sharon Bell Buchbinder, Nancy H. Shanks; Jones and Bartlett Learning, Massachusetts; 1
3.	**Healthcare Management** Walshe, Kieran, Smith, Judith; McGraw Hill, New York; 2011

Course Outcome

After Learning the Course the students shall be able to:

1. Basic Management, elements of healthcare management, organizational hierarchy, Introduction to principles of management in Healthcare environment, health ergonomics and related technologies.
2. Importance of Healthcare service providers, knowledge about the healthcare market in India, important requirement of health care setup system.
3. Comprehend indian and global healthcare market and organisation structure.
4. Knowledge of Various hierarchy of hospital system, Role of biomedical engineers.
5. Communication within the hospital, Orientation and budgeting.
6. Implementation of Computer and Information Management in Hospitals, software for billing, maintenance of patient records.

203231153 - Advanced Biomedical imaging

Course	Master of Technology (MTech)	**Semester - 2**
Type of Course	-	
Prerequisite	Basic Requirement of physics, Knowledge about image signal	
Course Objective	The course aims to provide comprehensive understanding of medical image acquisition in different modalities and the historical evolution of these imaging methods, to acquaint the students with different reconstruction techniques and noise removal for medical images and to apprise the manipulation of acoustic radiation fields for medical applications, to relate all the modules employed in magnetic resonance imaging and to demonstrate knowledge, clinical and technical skills and decision-making capabilities with respect to diagnostic imaging, to investigate the relevant theory to apply imaging principles for 3D visualization.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
Lecture	Tutorial	Lab	Credit	T	T	P	P	
3	0	2	4.00	60	20	30	20	150

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**X-ray Projection Imaging** X-Ray tubes, cooling systems, removal of scatters, Fluoroscopy- construction of image –Intensifier tubes, Angiographic setup, Mammography, Scanning methods, Area detectors - Digital radiology, DSA - Electronic portal imaging - Noise, Artefacts.	5	10
2	**X ray Computed Tomography** Principles of sectional scanning - CT detectors, Helical CT, Multi-slice CT, Cone beam CT imaging methods - Methods of reconstruction- Iterative, Back projection, convolution and Back-Projection, FDK algorithm - Noise, Artefacts.	5	10
3	**Radio Isotopic Imaging** SPECT- Radiation detectors, Radionuclides for imaging, Gamma ray camera, scanners, Positron Emission tomography - Iterative reconstruction algorithms, SPECT/CT, PET/CT registration.	10	25
4	**Ultrasonic Systems** Wave propagation and interaction in Biological tissues - Acoustic radiation fields, continuous and pulsed excitation - Transducers and imaging systems - Scanning methods, Imaging Modes, Principles and theory of image generation - lap top style units – Applications.	8	20
5	**Magnetic Resonance Imaging** NMR - Principles of MRI, Relaxation processes and their measurements, Pulse sequencing and MR image acquisition, Image reconstruction, Functional MRI, Diffusion imaging, EPI.	5	10
6	**Optical and other imaging modalities**	5	10

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
	Microscopic imaging principle and applications - Optical coherence tomography, principle, applications - Endoscopic image processing and applications - Electrical source imaging -Electrical impedance tomography - Microwave imaging.		
7	**Image processing for medicine** Image segmentation - Computational anatomy - Registration of multi-modality images - Synthesis of parametric images - Data visualization - Treatment planning.	7	15
	Total	45	100

Reference Books

1.	**Webb's Physics of Medical Imaging** M A Flower; CRC Press, Florida; 2
2.	**Medical Imaging Signals and Systems** Jerry L. Prince and Jonathan M. Links; Pearson Education Inc., London; 2
3.	**Fundamentals of Medical Imaging** Paul Suete; Cambridge University Press, Cambridge; 3

List of Practical

1.	To study X-ray imaging with Diagnostic methods.
2.	Calibration of X-ray machine.
3.	To study Computed Tomography with image characteristics.
4.	Demonstration of CT-scan machine.
5.	To study Image Reconstruction algorithms for CT scan.
6.	To study Ultrasonography with different Modes.
7.	Demonstration and operation of Ultra sonic machine along with transducer & patient cable.
8.	To study Color Doppler Flow Imaging and 2-D echo cardiography.
9.	To study Magnetic Resonance Imaging.
10.	To study Single Photon Emission Computed Tomography.
11.	To study Positron Emission Tomography.
12.	To study Microscopic imaging.
13.	To study image processing tools in medicine.
14.	To study Microwave imaging.
15.	To study Endoscopic image processing.

Course Outcome

After Learning the Course the students shall be able to:

1. To comprehend the acquisition techniques involved in different modalities of medical imaging
2. To conceive the historical evolution of the imaging methods pertaining to computed tomography.
3. To excel with different reconstruction techniques and programming techniques for noise removal.
4. To manipulate of acoustic radiation fields for diagnostics to be skillful in image generation.
5. Establish the principle of operation and modules employed in magnetic resonance imaging.
6. Able to develop decision-making capabilities with respect to diagnostic imaging.
7. To compare the available processes, validate and interpret the medical images for a given Application.

203231180 - Biomedical Image Processing and Analysis

Course	Master of Technology (MTech)	**Semester - 2**
Type of Course	-	
Prerequisite	Fundamentals of Image acquisition, Sensors	
Course Objective	The course aims to define the principles of image sampling, quantization, enhancement and filtering techniques, to discover the different image compression methods and morphological based processes and machine learning techniques for image segmentation, to develop the methods of image registration and visualization for medical applications, to acquire the student with the techniques of shape analysis and image classification using neural networks for brain computer interface and computer aided diagnosis.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
Lecture	Tutorial	Lab	Credit	T	T	P	P	
3	0	2	4.00	60	20	30	20	150

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Image Fundamentals** Image perception- Image model- Image sampling and quantization - 2D DFT and DCT.	5	10
2	**Image Enhancement and Filtering** Image enhancement- Histogram modelling, Spatial operations - Image restoration, Noise models, Image degradation model, Wiener filtering, Maximum entropy restoration.	5	10
3	**Image Compression and Morphological Processing** Image compression - Lossy and lossless Compression, Predictive techniques - Dilation, Erosion, Open, Close, Skeleton operations, Top-hat algorithm - Morphology based segmentation.	5	10
4	**Image Segmentation** Machine Learning based segmentation algorithms - Singular Value Decomposition (SVD) -Principal Component Analysis and its applications - Support Vector Machine and its applications -Independent Component Analysis and its application.	10	25
5	**Image Registration and Visualization** Image Registration - Medical image Fusion, SPECT/CT, MR/CT, PET/CT - Image visualization -Volume Rendering, Surface rendering and Maximum Intensity Projection.	5	10
6	**Shape Analysis and Image Classification** Topological attributes - Shape orientation descriptors, Fourier descriptors, - K means clustering, machine learning, Neural Network approaches- Statistical Parametric Mapping in Imaging - Regression analysis.	5	10
7	**CAD and Brain Computer Interface**	10	25

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
	Applications of Computer Aided Design (CAD) - General Linear Model (GLM) and its application in functional brain mapping - Group analysis using t-test - Computer Aided Manufacturing (CAM) in Medical Imaging applications, Patient specific modelling - Brain Computer Interface (BCI) and its applications in Neuroscience.		
	Total	**45**	**100**

Reference Books

1.	**Biomedical Imaging: Principles and Applications** Reiner Salzer; Wiley, New Jersey.; 1st 2012
2.	**Brain-Computer Interfaces: Principles and Practice (TextBook)** Jonathan Wolpaw, Elizabeth Winter, (Eds.); Oxford University Press, Oxford; 1st 2012
3.	**3D Imaging, Analysis and Applications** Pears, Nick, Liu, Yonghuai, Bunting, Peter (Eds.); Springer, Berlin; 2

List of Practical

1.	To study the Image Processing concept.
2.	To obtain histogram equalization image.
3.	To implement smoothing or averaging filter in spatial domain.
4.	Program for opening and closing of the image.
5.	To fill the region of interest for the image.
6.	Implementation for edge detection algorithm.
7.	Implementation of sharpen image using gradient mask.
8.	Implementation of Image Intensity slicing technique for image enhancement.
9.	Implementation of image restoring techniques.
10.	Implementation for morphological operation: Erosion and Dilation
11.	To Implement Image Compression algorithm.
12.	Computation of Mean, Standard Deviation, Correlation coefficient of the given Image.
13.	Display of FFT (1-D & 2-D) of an image.
14.	Display of bit planes of an Image.
15.	Implementation of Water shed Algorithm.

Course Outcome

After Learning the Course the students shall be able to:

1. Comprehend image sampling and DFT.
2. Process the given medical images to enhance.
3. Apply compression techniques and morphological operations for segmentation.
4. Predict a machine learning algorithm on the given image for segmentation.
5. Register images of different modalities, render their volumes for visualization.
6. Use neural networks for image classification.
7. Design and develop algorithms to process and visualize images from different modalities.
8. Develop algorithms to process and visualize images from different modalities for Diagnostic application.

203231181 - Biomedical Equipment

Course	Master of Technology (MTech)	**Semester - 2**
Type of Course	-	
Prerequisite	Fundamentals of Medical Electronics, Biomedical Instrumentation	
Course Objective	The course aims to discuss and express the basic principle, working and design of various bio potential recording equipment, To acquaint the students with the different types of flowmeters and radiation detectors and the analytical equipment used in medical field, To describe the modes of operation and functioning of cardiac and respiratory devices, To provide a comprehensive knowledge of the features of extracorporeal dialysis units, Physiotherapy and surgical equipment.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		
Lecture	**Tutorial**	**Lab**	**Credit**	**T**	**T**	**P**	**P**	**Total Marks**
3	0	2	4.00	60	20	30	20	150

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Bio Potential Recording** Introduction to ECG, EEG, EMG, PCG, EOG, lead system and recording methods, typical waveform, frequency spectrum, abnormal waveforms. Evoked response, Electroencephalography, Electrocardiography, Electromyography.	5	10
2	**Analytical & Diagnostic Instruments** Common analytical equipment used in hospitals and those in Biochemistry laboratories - Blood Flow meters - Pulmonary function analyzers - Blood gas analyzers - Different types of Oximetry systems - Blood pressure measurement - Blood cell counters.	5	10
3	**Blood Flow Meters and Radiation Detectors** Ultrasonic blood flow meters, NMR blood flow meter, Laser Doppler blood flow meters, Pulse oximeter- Radiation detectors, Pulse height analyzer, Gamma camera, Medical ultrasound, Basic pulse echo apparatus.	10	25
4	**Cardiac Devices** External and Implantable Pacemaker, Performance aspects of Implantable Pacemaker - DC defibrillator, Modes of operation and electrodes, Performance aspects of dc-defibrillator, Implantable defibrillator, defibrillator analyzers - Heart lung machine- Different types of Oxygenators, Pumps.	8	20
5	**Hemodialysis Machine** Basic principle of Hemodialysis and its type - Membrane, Dialysate, Different types of hemodialyzers, Monitoring Systems, Portable and Wearable Artificial Kidney, Implanting Type - Different types of dialyzer membrane.	5	10
6	**Physiotherapy and Surgical Instruments**	5	10

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
	Basic principle, working and technical specifications of Shortwave Diathermy - Ultrasonic therapy unit, Infrared and UV lamps - Nerve and Muscle Stimulator - Surgical Diathermy machine, Electrodes used with surgical diathermy, Safety aspects in electronic surgical units, Surgical diathermy analyzers.		
7	**Ventilators and Anaesthesia System** Basic principles of ventilators, Different generators, Inspiratory phase and expiratory phase, Different ventilator adjuncts, Neonatal ventilators, Ventilator testing - Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Anaesthesia - Need of anaesthesia, Gas used and their sources, Gas blending and vaporizers, Anaesthesia delivery system, Breathing circuits.	**7**	**15**
	Total	**45**	**100**

Reference Books

1.	**"Introduction to Biomedical Equipment Technology"** Carr & Brown,; Pearson Education, Asia.
2.	**Medical Instrumentation Application and Design** J. G. Webster; John Wiley & Sons, N.Y
3.	**Handbook of Biomedical Instrumentation** Kandpur R. S,; Tata McGraw Hill, New Delhi

List of Practical

1.	Identify ECG electrodes & Patient cable.
2.	Identify EEG electrodes & Patient cable.
3.	Identify EMG electrodes.
4.	Measure blood pressure using sphygmomanometer.
5.	Calibrate & maintain ECG machine.
6.	Obtain EEG of patient using EEG machine.
7.	Demonstrate the Performance of EMG.
8.	Demonstrate the performance of Electro surgery – cautery machine.
9.	Identify parts of Hemo-dialysis machine.
10.	Demonstrate operation of Blood Cell Counter.
11.	Demonstrate operation of Bio chemistry analyzer.
12.	To study about Defibrillator.
13.	To study about Ventilator & Anesthesia machine.

Course Outcome

After Learning the Course the students shall be able to:

1. Envision the design of various bio potential recording equipment and its applications
2. Comprehend the working principle and applications of the analytical equipment used in medical field.
3. Perceive the advantages and disadvantages of the different types of flowmeters and radiation detectors; limits of usage.
4. Develop first end devices for cardiology applications and to monitor respiratory parameters.
5. Summarize the variety of dialysis units, its supporting facilities and various kinds of dialyzers.
6. Intuit the application of physiotherapy and surgical equipment; range of operation.

203231182 - Medical Product Design: Standards & Regulation

Course	Master of Technology (MTech)	**Semester - 2**
Type of Course	-	
Prerequisite	Knowledge about CAD -CAM, Floorplanning	
Course Objective	The course aims to gain knowledge in various aspects of health informatics and medical standards, to apply these techniques in proper health care delivery.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
Lecture	Tutorial	Lab	Credit	T	T	P	P	
3	0	2	4.00	60	20	30	20	150

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Electronic Patient Record and Standards** Electronic Patient Record, Medical data formats, Medical Standards, HL7, DICOM, LOINC, PACS, Medical Standards for Vocabulary, ICD 10, DRG, MeSH, UMLS, SNOMED. Healthcare Standards - JCAHO, HIPAA	11	20
2	**Electronic Decision Support Systems** Biomedical decision making. Probabilistic clinical reasoning. Medical Knowledge and Decision Support, Methods for decision support, Clinical decision-support systems, Strategies for medical knowledge acquisition, Predictive tools for clinical decision support.	12	25
3	**Bioinformatics Tools** NCBI, Human Genome Project, GenBank, Sequence alignment, BLAST, FASTA, CLUSTALW, Phylogenetic Analysis.	5	15
4	**Norms for Hospitals** Design and construction standards for the hospitals, BIS –India, JCIA, AIA and NHS, general guidelines and standard for out-patient area, in-patient area and diagnostic area in the hospitals.	12	25
5	**Standards for Hospitals** Voluntary & Mandatory standards, General standards, Mechanical standards, Electrical Standards, Standard for centralized medical gas system, Standards for biomedical waste.	5	15
	Total	45	100

Reference Books	
1.	**Biomedical Informatics: Computer Applications in Health Care and Biomedicine (Health Informatics)** Edward H. Shortliffe, James J. Cimino; Springer, New York; 4
2.	**Medical Informatics: An Executive primer** Kenneth R. Ong; HIMSS Publishing; 1
3.	**Web-Based Applications in Healthcare and Biomedicine, Annals of Information Systems** Lazakidou, Athina A; Springer, New York; 7th

List of Practical	
1.	To study about Electronic patient records and standards.
2.	To study about Electronic decision support system.
3.	To study about general guidelines and standards for outpatient area.
4.	To study about Voluntary standards of Hospital.
5.	To study about Mandatory standards of Hospital.
6.	To study about Electrical standards of Hospital.
7.	To study about standards for biomedical waste.
8.	To study about standards for centralized medical gas system.
9.	To study about the BLAST, FASTA, CLUSTALW tools of Bioinformatics.
10.	To study about NCBI.

Course Outcome

After Learning the Course the students shall be able to:
1. Understand the basic concepts in Biomedical Informatics. 2. Apply the various aspects of health informatics and medical standards. 3. Develop clinical decision support systems. 4. Comprehend the basics of bioinformatics and the resources in the field. 5. Analyze various bioinformatics tools and explore the databases available in NCBI. 6. Design and implement the construction standards in a hospital. 7. Apply the standards in proper health care delivery.

203231183 - Bioinformatics

Course	Master of Technology (MTech)	**Semester - 2**
Type of Course	-	
Prerequisite	Basic Knowledge about Protein, and coding	
Course Objective	The course aims to understand the basic concepts in Biomedical Informatics, to apply the various aspects of health informatics and medical standards, to develop clinical decision support systems, to comprehend the basics of bioinformatics and the resources in the field, to analyze various bioinformatics tools and explore the databases available in NCBI, to design and implement the construction standards in a hospital, to apply the standards in proper health care delivery.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		
Lecture	Tutorial	Lab	Credit	T	T	P	P	Total Marks
3	0	2	4.00	60	20	30	20	150

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Introduction** Introduction to Operating systems, Linux commands, File transfer protocols ftp and telnet, Introduction to Bioinformatics and Computational Biology, Biological sequences, Biological databases, Genome specific databases, Data file formats, Data life cycle, Database management system models, Basics of Structured Query.	7	15
2	**Sequence Alignment** Sequence Analysis, Pair wise alignment, Dynamic programming algorithms for computing edit distance, string similarity, shotgun DNA sequencing, end space free alignment. Multiple sequence alignment, Algorithms for Multiple sequence alignment, Generating motifs and profiles, Local and Global alignment, Needleman and Wunsch algorithm, Smith Waterman algorithm, BLAST, PSIBLAST and PHIBLAST algorithms.	9	20
3	**Phylogenetic Methods** Introduction to phylogenetics, Distance based trees UPGMA trees, Molecular clock theory, Ultrametric trees, Parsimonious trees, Neighbour joining trees, trees based on morphological traits, Bootstrapping. Protein Secondary structure and tertiary structure prediction methods, Homology modeling, abinitio approaches, Threading, Critical Assessment of Structure Prediction, Structural genomics.	12	25
4	**Protein Structure Analysis** Machine learning techniques: Artificial Neural Networks in protein secondary structure prediction, Hidden Markov Models for gene finding, Decision trees, Support Vector Machines. Introduction to Systems Biology and Synthetic Biology, Microarray analysis, DNA computing,Bioinformatics approaches for drug discovery, Applications of informatics techniques in genomics and proteomics: Assembling the genome, STS content mapping for clone contigs, Functional annotation, Peptide mass fingerprinting.	9	20
5	**Perl Programming**	9	20

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
	Basics of PERL programming for Bioinformatics: Data types: scalars and collections, operators, Program control flow constructs, Library Functions: String specific functions, User defined functions, File handling.		
	Total	**46**	**100**

Reference Books

1.	**Biomedical Informatics: Computer Applications in Health Care and Biomedicine (Health Informatics)** Edward H. Shortliffe, James J. Cimino; Springer, New York; 4
2.	**Medical Informatics: An Executive primer** Kenneth R. Ong; HIMSS Publishing; 1
3.	**Web-Based Applications in Healthcare and Biomedicine, Annals of Information Systems** 3. Lazakidou, Athina A; Springer, New York; 7

List of Practical

1.	To perform pairwise sequence alignment using BLAST.
2.	To perform multiple sequence alignment using ClustalW.
3.	To assemble a genome using SPAdes.
4.	To annotate genomic data using Prokka.
5.	To predict protein structure using Swiss-Model.
6.	To analyze protein-protein interaction networks using STRING.
7.	To construct a phylogenetic tree using MEGA.
8.	To analyze RNA-Seq data using HISAT2 and DESeq2.
9.	To predict molecular interactions using AutoDock.
10.	To visualize 3D structures of biomolecules using PyMOL.
11.	To integrate multi-omics data using Cytoscape.
12.	To script bioinformatics tasks using Biopython.
13.	To retrieve biological data from public databases like NCBI.
14.	To analyze clinical genomics data using GATK.
15.	To apply machine learning techniques in bioinformatics using Scikit-learn.

Course Outcome

After Learning the Course the students shall be able to:

1. Understand the basic concepts in Biomedical Informatics.
2. Apply the various aspects of health informatics and medical standards.
3. Develop clinical decision support systems.
4. Comprehend the basics of bioinformatics and the resources in the field.
5. Analyze various bioinformatics tools and explore the databases available in NCBI.
6. Design and implement the construction standards in a hospital.
7. Apply the standards in proper health care delivery.

203231184 - Cardiovascular System and Dynamics

Course	Master of Technology (MTech)	**Semester - 2**
Type of Course	-	
Prerequisite	Fundamentals of Anatomy and Physiology of Heart, Blood Flow	
Course Objective	The course aims to attain comprehensive knowledge and understanding of the vascular system, the heart and the blood system in terms of function and basic structure. This will enable the students to understand the types of blood flow that occurs into the blood vessel and how blood interacts with the walls of the blood vessel. The reason for emphasizing on the fundamental aspects is that it will provide a detailed understanding of the properties associated with the system, at a level which students and teachers at this age range can feel comfortable with.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		
Lecture	Tutorial	Lab	Credit	T	T	P	P	Total Marks
3	0	2	4.00	60	20	30	20	150

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Introduction** Cardiovascular system of human body, Electrical system of the heart, Mechanical events in cardiac cycle, correlation between mechanical and electrical events in the heart, coronary circulation, Microcirculation.	5	10
2	**Blood Rheology** Kinetic energy, pressure-volume relations in ventricles, cardiac valve dysfunction, blood pressure regulation and controlling factors, heart failure, Blood hematology and blood Rheology, Blood characteristics, Abnormalities of blood, Blood types, Plasma viscosity, blood pH.	13	25
3	**Fluid Mechanics** Introduction to fluid mechanics, fluid properties, basic laws of conservation of mass, energy and momentum, Stress, Strain, Elasticity, Hook's law, Newton's laws of viscosity, Power law constitutive model for blood, Fluid characteristics and viscosity, calculation of yield stress for blood.	9	25
4	**Mechanism of Fluid** Types of fluid flow , Laminar blood flow, Turbulent blood flow, Importance of turbulence, Newtonian fluids, Non Newtonian fluids, Laminar Flow of Non Newtonian Fluids, Flow of Newtonian and non-Newtonian fluid in rigid, flexible and collapsible tubes, blood flow through arteries and veins, methods for measuring viscosity, forces that drive or resist blood flow, Vascular resistance to blood flow, Reynolds number, Poiseuille's law, Application of Poiseuille's law, Bernoulli equation, Pulsatile Flow.	9	20
5	**Applications of Cardiovascular system & Dynamics** Anatomy and physiology of blood vessels, Wave phenomena in blood vessels, Types of vessels, Mechanics of arterial walls, Compliance, Windkessel model, vascular pathologies, coronary artery bypass grafting (CABG), Intra-Aortic Balloon Pump (IABP).	9	20
	Total	45	100

Reference Books

1.	**Biomechanics: Circulation** Y.C.Fung; Springer Verlay. New York
2.	**Biofluid Dynamics** P. Nithiarasu; School of Engineering, Swansea University, SWansea
3.	**Biofluid Mechanics** Jagan. N. Mazumdar; World scientific
4.	**Biofluid Mechanics** Krishna B. Chandran, Stanley E.; The Human Circulation; 2
5.	**Biofluid mechanics in cardiovascular system** Lee Waite; . Mc Grawhill
6.	**Snapshots of Hemodynamzics** Nico Westerof; Springer
7.	**Cardiovascular Fluid Mechanics** - F.N. van de Vosse and M.E.H. van Dongen; Eindhoven University of Technology
8.	**The Cardiovascular System: Mathematical Modeling, Numerical Algorithms** A.; Manzoni, A.; Vergara, C., Politecnico di Milano, Milano

List of Practical

1.	To perform the simulation of blood flow in stenosis arteries.
2.	To analyze the Wall Shear Stress in bifurcated vessels.
3.	Modeling non-Newtonian blood flow in capillaries.
4.	To observe the pulsatile flow simulation in elastic arteries.
5.	To study the thrombus formation in blood vessels.
6.	To observe the flow blood flow distribution in serpentine channel.
7.	To observe the blood flow in porous channel.
8.	To observe the impact of blood viscosity variations on flow dynamics.
9.	To perform the simulation for oxygen transport in capillaries.
10.	Study of turbulent blood flow in large arteries.

Course Outcome

After Learning the Course the students shall be able to:

1. Understand the physiology and anatomy of the heart and circulatory system.
2. Influence of pressure in maintaining the blood pressure and heart rate.
3. To analyse the Fluid characteristics and viscosity.
4. Integrate fluid dynamics engineering concepts to examine and to model the biological flow in human body.
5. Development of mathematical models of the cardiovascular system.

203231185 - Medical Optics

Course	Master of Technology (MTech)	**Semester - 2**
Type of Course	-	
Prerequisite	Basic knowledge of Analog & Digital Electronics, Physics, & engineering mathematics.	
Course Objective	The course aims to understand various aspects of optics in Tissues, to identify and develop an understanding for various applications of laser in diagnosis and therapy.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		
Lecture	Tutorial	Lab	Credit	T	T	P	P	Total Marks
3	0	2	4.00	60	20	30	20	150

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Optical Properties Of The Tissues** Refraction, Scattering, Absorption, Light transport inside the tissue, Tissue properties, Laser Characteristics as applied to medicine and biology-Laser tissue Interaction-Chemical-Thermal-Electromechanical – Photoabalative processes.	5	10
2	**Instrumentation In Photonics** Instrumentation for absorption, Scattering and emission measurements, excitation light sources high pressure arc lamp, LEDs, Lasers, Optical filters, - optical detectors Time resolved andphase resolved detectors.	8	20
3	**Surgical Applications Of Lasers** Lasers in ophthalmology- Dermatology – Dentistry-Urology-Otolaryngology - Tissue welding.	12	25
4	**Non-Thermal Diagnostic Applications** Optical coherence tomography, Elastography, Laser Induced Fluorescence (LIF)-Imaging, FLIMRaman Spectroscopy and Imaging, FLIM – Holographic and speckle application of lasers inbiology and medicine.	12	25
5	**Therapeutic Applications** Phototherapy, Photodynamic therapy (PDT) - Principle and mechanism - Oncological andnononcological applications of PDT - Bio stimulation effect – applications-Laser Safety Procedures.	8	20
	Total	45	100

Reference Books

1.	**Laser-Tissue Interaction Fundamentals and Application** MarkolfH.Niemz; Springer; 2007
2.	**Introduction to Biophotonics** Paras N. Prasad; A. John Wiley and Sons, Inc. Publications; 2003
3.	**Handbook of Biomedical Instrumentation** R.S.Khandpur
4.	**Medical Instrumentation Application and Design** J. G. Webster; John Wiley & Sons, N.Y

List of Practical

1.	To study electromagnetic spectrum.
2.	To study the structure of optical fiber and its working principle.
3.	To study the propagation of light through straight and bend fiber.
4.	To study the terminology related to fiber optic communication.
5.	To study losses and dispersion in fiber optics.
6.	To study the working principle of LASER.
7.	To study various types of LASER used in biomedical engineering.
8.	To study the application of LASER in Neurosurgery.
9.	To study the application of LASER in Gastroenterology.
10.	To study the application of LASER in Ophthalmology.
11.	To study the application of LASER in Oncology.
12.	To study the application of LASER in Urology.
13.	To study the application of LASER in Orthopedics.
14.	To study the principle and construction of Endoscopy.
15.	To study fiber optic biomedical sensors and its coupling with fibers.

Course Outcome

After Learning the Course the students shall be able to:

1. Understand the LASER physics, Light and its working principle with different modes of operation.
2. Learn the construction, working principle of fibers and Light propagation through fibers.
3. Learn biomedical sensor integration with optical fiber and thus its emerging various therapeutic, diagnostic as well as imaging application, its advantages and safety aspects.
4. Understand the various applications for curing different diseases accurately by fiber optic laser system in an easy, fast and safe method of operation.

203231201 - Phase - I Dissertation

Course	Master of Technology (MTech)	**Semester - 3**
Type of Course	-	
Prerequisite	Students must have completed core and elective courses in their specialization along with Research Methodology, enabling them to identify and define a research problem.	
Course Objective	It initiates students into research by guiding them to select a relevant problem, review literature, and formulate a structured research plan, laying the foundation for Dissertation Phase II.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
0	0	20	10.00	-	-	100	100	200

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Outcome

After Learning the Course the students shall be able to:

1. Identify and define a relevant research problem through a comprehensive literature survey.
2. Formulate clear objectives, hypotheses, and methodologies for solving the identified problem.
3. Develop a project proposal, including timelines, resources, and expected outcomes.
4. Demonstrate the ability to use research tools, software, and techniques relevant to their domain.
5. Communicate the research plan effectively through a well-structured interim report and oral presentation.

203231230 - Medical Robotics

Course	Master of Technology (MTech)	**Semester - 3**
Type of Course	-	
Prerequisite	Basic knowledge of Kinematics and Mechanics is must.	
Course Objective	To enable understanding the design and control concepts of medical robots and comprehend on the application of robotics in the field of healthcare, also basic understanding of robotics for general automation.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
3	0	0	3.00	60	20	-	-	100

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Introduction to robots** Robots as mechanical devices - Classification of robotic manipulators - Robotic systems - Accuracy and repeatability - Wrists and end-effectors - Mathematical modeling of robots - Symbolic representation of robots - The configuration space - The state space - The workspace Common kinematic arrangements of manipulators - Forward kinematics - Inverse kinematics - Velocity kinematics	8	20
2	**Spatial Position and Orientation of Robots** Kinematic aspects of robotic systems, including Angles, Linkages, Three-Joint Robot, and Standardizing Kinematic Analysis. Explore the classification of robotic manipulators, robotic systems, accuracy, repeatability, wrists, end-effectors, mathematical modeling, symbolic representation, configuration space and the state space.	9	20
3	**Robot Kinematics** Exploration of robotic systems, encompassing Three-Joint Robot, Six-Joint Robot, Inverse Solution for the Seven-Joint DLR-Kuka Robot, along with C-arm, Center-of-Arc Kinematics, and Surgical Microscopes.	8	15
4	**Applications of Surgical Robotics** Comprehensive coverage of medical disciplines including Radiosurgery, Orthopedic Surgery, Urologic Surgery, Robotic Imaging, and Cardiac Surgery, highlighting the diverse realms of expertise in the field.	9	20
5	**Rehabilitation and Surgery using Robotics** Assisted laparoscopic surgery, Haptic feedback in robotic heart surgery, Robotic applications in neurosurgery, Miniature robotic guidance for spine surgery. A comprehensive study covering Rehabilitation for Limbs, Brain-Machine Interfaces, and the innovative field of Steerable Needles, delving into the advancements and applications in each area to address diverse aspects of healthcare and technology integration	9	25
	Total	43	100

Reference Books

1.	**Medical Robotics** Achim Schweikard, Floris Ernst; Springer; 2015
2.	**Medical Robotics** Vanja Bozovic; Springer; 2008
3.	**Robot Modeling and Control** Mark W. Spong, Seth Hutchinson, M. Vidyasagar; John Wiley & Sons; 2005

Course Outcome

After Learning the Course the students shall be able to:

1. Understand the fundamentals of medical robotics, including the classification of robotic manipulators, kinematic models, workspace analysis, and the role of end-effectors in healthcare applications.
2. Analyze spatial position and orientation in robotic systems using forward and inverse kinematics, and evaluate robotic manipulators based on performance parameters such as accuracy, repeatability, and configuration.
3. Explain the kinematic structures and movements of various robotic systems, including three-joint, six-joint, and seven-joint robots, and understand their applications with C-arm and surgical microscopes.
4. Evaluate applications of surgical robotics across different medical specialties such as radiology, orthopedic surgery, urology, cardiology, and robotic imaging, with a focus on operational advantages and limitations.
5. Demonstrate understanding of robotic systems in rehabilitation and minimally invasive surgery, including haptic feedback, brain-machine interface

203231231 - Biodynamics

Course	Master of Technology (MTech)	**Semester - 3**
Type of Course	-	
Prerequisite	Basic knowledge of knowledge of human biology or biomechanics.	
Course Objective	This course will introduce you to the anatomical, physiological and biomechanical principles needed to understand how everyday movements such as walking, running and jumping are possible. The roles of the skeleton and various skeletal tissues will be examined, along with the interaction of the body with its environment, to uncover the secrets of human movement and help explain why sometimes we get injured. This course and lab examines the biomechanical principles that relate to the human body and performance. Concepts on mechanical factors on human movement from a disability, rehabilitative, and sports perspective will also be discussed.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
Lecture	Tutorial	Lab	Credit	T	T	P	P	
3	0	0	3.00	60	20	-	-	100

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Introduction to Human Body Structure and Motion** **Human Body Structure:** Skeletal Tree, Bone, Cartilage, and Ligaments, Joints of the Human Body, Physical Properties of Skeletal Muscle, Muscle Groups and Movement. **Particles in Motion:** Conservation of Linear Momentum, Center of Mass and Its Motion, Multiplication of Vectors, Moment of a Force, Moment of Momentum About a Stationary Point, Moment of Momentum About the Center of Mass.	10	18
2	**Bodies in Planar Motion and Statics** Planar Motion of a Slender Rod, Angular Velocity, Angular Acceleration, Angular Momentum, Conservation of Angular Momentum, Applications to Human Body Dynamics, Instantaneous Centre of Rotation, Equations of Static Equilibrium, Contact Forces in Static Equilibrium, Structural Stability and Redundancy, Structures and Internal Forces, Distributed Forces.	10	22
3	**Internal Forces and the Human Body** Complexity of the Musculoskeletal System, Muscle Force in Motion, Examples from Weight Lifting, Arm and Joint Angle, Multiple Muscle Involvement in Flexion of the Elbow, Biarticular Muscles, Physical Stress, Musculoskeletal Tissues, Limb-Lengthening	10	20
4	**Impulse and Momentum and Energy Transfers** Principle of Impulse and Momentum, Angular Impulse and Angular Momentum, Elasticity of Collision: Coefficient of Restitution, Initial Motion Kinetic Energy, Potential Energy, Conservation of Mechanical Energy, Multibody Systems, Applications to Human Body Dynamics	10	20
5	**Three-Dimensional Motion**	8	20

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
	Time Derivatives of Vectors, Angular Velocity and Angular Acceleration, Conservation of Angular Momentum, Dancing Holding on to a Pole, Rolling of an Abdominal Wheel on a Horizontal Plane, Biomechanics of Twisting Somersaults, Throwing and Hitting Motions.		
	Total	**48**	**100**

Reference Books

1.	**Introduction to Sports Biomechanics: Analysing Human Movement Patterns** Roger Bartlett; Taylor & Francis; Second Edition, 2007
2.	**Fundamental of Biomechanics** Knudson Duane; Springer; Second Edition, 2007
3.	**Human Body Dynamics: Classical Mechanics and Human Movement** Aydın Tözeren; Springer-Verlag New York, Inc., 2000
4.	**Biomechanics and Motor Control of Human Movement** David A. Winter; John Wiley & Sons; 4th Edition, 2009
5.	**Biomechanical Basis of Human Movement** Lippincott Williams and Wilkins, Joseph Hamill, 1995

Course Outcome

After Learning the Course the students shall be able to:

1. Explain the structure and mechanical function of skeletal muscles, bones, joints, and ligaments, and apply principles of particle motion to human body dynamics.
2. Analyze planar motion and statics of human body segments using concepts like angular velocity, momentum, static equilibrium, and internal force systems.
3. Evaluate internal forces acting on the human musculoskeletal system and their implications in physical activities such as lifting, joint motion, and muscle mechanics.
4. Apply principles of impulse, momentum, and energy transfer to biomechanical events and interpret the dynamics of multibody systems in human motion.
5. Demonstrate understanding of three-dimensional motion in the human body, including angular motion, rotational dynamics, and biomechanical analysis of complex actions like somersaults and throwing.

203231232 - Basics of Artificial Intelligence

Course	Master of Technology (MTech)	**Semester - 3**
Type of Course	-	
Prerequisite	Basic knowledge of Algebra, Probability and Statistics is must.	
Course Objective	To have a comprehensive understanding of artificial intelligence concepts, techniques, and applications, while also fostering critical thinking, problem-solving skills, and ethical awareness.	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
3	0	0	3.00	60	20	-	-	100

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Introduction Artificial Intelligence** AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.	7	15
2	**AI Search and Game Playing Strategies** Searching- Searching for solutions, uniformed search strategies – Breadth first search, depth first Search. Search with partial information (Heuristic search), Hill climbing, A*, AO* Algorithms. Problem reduction, Game Playing-Adverbial search, Games, mini-max algorithm, optimal decisions in multiplayer games, Problem in Game playing, Alpha-Beta pruning and Evaluation functions.	12	25
3	**Knowledge Representation and Reasoning in AI** Knowledge representation issues, predicate logic- logic programming, semantic nets- frames and inheritance, constraint propagation, representing knowledge using rules, rules based deduction systems. Reasoning under uncertainty, review of probability, Baye's probabilistic interferences and dempstershafer theory.	7	15
4	**Logical Inference, Learning, and Reasoning** First order logic. Inference in first order logic, propositional vs. first order inference, unification & lifts forward chaining, Backward chaining, Resolution, Learning from observation, Inductive learning, Decision trees, Explanation based learning, Statistical Learning methods, Reinforcement Learning.	10	20
5	**Artificial Neural Networks: Structure, Function, and Applications**	10	25

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
	Artificial Neural Networks (ANN) and their biological roots and motivations. ANNs as numerical data/signal/image processing devices.a summing dendrite, synapses and their weights, pre- and postsynaptic signals, activation potential and activation function. Excitatory and inhibitory synapses. The biasing input. Types of activating functions.Encoding (training phase) and decoding (active phase). Taxonomy of neural networks:-feedforward and recurrent networks with supervised and unsupervised learning laws, static &dynamic processing systems.		
	Total	**46**	**100**

Reference Books

1.	**Artificial Intelligence – A Modern Approach** S. Russel and P. Norvig; Pearson Education; Second Edition
2.	**Computational Intelligence: a logical approach** David Poole, Alan Mackworth, Randy Goebel; Oxford University Press
3.	**Artificial Intelligence: Structures and Strategies for complex problem-solving** G. Luger; Pearson Education; Fourth Edition
4.	**Artificial Intelligence: A new Synthesis** J. Nilsson; Elsevier Publishers

Course Outcome

After Learning the Course the students shall be able to:

1. Understand the foundations of Artificial Intelligence, including intelligent agents, types of environments, problem-solving approaches, and agent-based system formulation.
2. Apply AI search algorithms and game-playing strategies such as uninformed and informed search, mini-max algorithm, and Alpha-Beta pruning to solve structured problems.
3. Demonstrate knowledge representation and reasoning skills using predicate logic, semantic networks, frames, and rule-based systems, and handle reasoning under uncertainty using Bayes' and Dempster-Shafer theories.
4. Implement logical inference and learning algorithms, including first-order logic inference, inductive learning, decision trees, and statistical learning approaches like reinforcement learning.
5. Analyze the structure and function of artificial neural networks (ANNs), understand training/testing processes, and differentiate between types of networks and learning paradigms.

203231251 - Phase - II Dissertation

Course	Master of Technology (MTech)	**Semester - 4**
Type of Course	-	
Prerequisite	-	
Course Objective	-	
Effective From A.Y.	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		
Lecture	Tutorial	Lab	Credit	T	T	P	P	Total Marks
0	0	32	16.00	-	-	100	100	200

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*