SRM UNIVERSITY
(Under section 3 of UGC Act 1956)

B.TECH (Full Time) - BIOMEDICAL ENGINEERING
Curriculum & Syllabus
Regulation - 2013

(Students who were admitted during 2014-15)

Volume- I
(all courses except open electives)

FACULTY OF ENGINEERING AND TECHNOLOGY
SRM UNIVERSITY
SRM NAGAR, KATTANKULATHUR – 603 203

STUDENT OUTCOMES

The curriculum and syllabus for B.Tech programs (2013) conform to outcome based teaching learning process. In general, **ELEVEN STUDENT OUTCOMES** (a-k) have been identified and the curriculum and syllabus have been structured in such a way that each of the courses meets one or more of these outcomes. Student outcomes describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that students acquire as they progress through the program. Further each course in the program spells out clear instructional objectives which are mapped to the student outcomes.

The student outcomes are:

a) an ability to apply knowledge of mathematics, science, and engineering

b) an ability to design and conduct experiments, as well as to analyze and interpret data

c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

d) an ability to function on multidisciplinary teams

e) an ability to identify, formulate, and solve engineering problems

f) an understanding of professional and ethical responsibility

g) an ability to communicate effectively

h) the broad education necessary to understand the impact of engineering solutions in global, economic, environmental, and societal context

i) a recognition of the need for, and an ability to engage in life-long learning

j) a knowledge of contemporary issues

k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

School of Bioengineering
Department of Biomedical Engineering
B.Tech Biomedical Engineering
Curriculum – 2014
(Applicable for students admitted from the academic year 2014-15 onwards)

SEMESTER I						
COURSE CODE	**CATEGORY**	**COURSE NAME**	**L**	**T**	**P**	**C**
PD1001	G	SOFT SKILLS I	1	0	1	1
MA1011	B	MATRICES AND CALCULUS	3	2	0	4
PY1001	B	PHYSICS	3	0	0	3
PY1002	B	PHYSICS LAB	0	0	2	1
CY1001	B	CHEMISTRY	3	0	0	3
CY1002	B	CHEMISTRY LAB	0	0	2	1
LE1002	G	VALUE EDUCATION	1	0	0	1
CE1001	E	BASIC CIVIL ENGINEERING	2	0	0	2
		Courses From Table I				
Student shall register for minimum 20 credits in I semester and minimum 20 credits in II semester. However student shall have registered for all the courses enlisted under Semester I and II as well the courses in Table I by the time the registration process is complete in II semester. Keeping this in mind student shall register for the courses in I and II semesters.						

Legend:

L - Number of lecture hours per week
T - Number of tutorial hours per week
P - Number of practical hours per week
C - Number of credits for the course

Category of courses:
G - General
B - Basic Sciences
E - Engineering Sciences and Technical Arts
P - Professional Subjects

SEMESTER II						
COURSE CODE	**CATEGORY**	**COURSE NAME**	**L**	**T**	**P**	**C**
PD1002	G	SOFT SKILLS II	1	0	1	1
MA1012	B	MULTIPLE INTEGRALS AND DIFFERENTIAL EQUATIONS	3	2	0	4
PY1003	B	MATERIAL SCIENCE	2	0	2	3
CY1003	B	PRINCIPLES OF ENVIRONMENTAL SCIENCE	2	0	0	2
LE1001	G	ENGLISH	1	2	0	2
BT1004	P	BIOCHEMISTRY	3	0	0	3
BM1001	P	MEDICAL ELECTRONIC DEVICES	3	0	0	3
BM1002	P	MEDICAL ELECTRONIC DEVICES LAB	0	0	2	1
		Courses from Table I				
Student shall register for minimum 20 credits in I semester and minimum 20 credits in II semester. However student shall have registered for all the courses enlisted under Semester I and II as well the courses in Table I by the time the registration process is complete in II semester. Keeping this in mind student shall register for the courses in I and II semesters.						

TABLE I
COURSES WHICH CAN BE REGISTERED FOR EITHER IN I OR II SEMESTER

SEMESTER I / II						
COURSE CODE	**CATEGORY**	**COURSE NAME**	**L**	**T**	**P**	**C**
CS1001	G	PROGRAMMING USING MATLAB	0	1	2	2
BT1001	B	BIOLOGY FOR ENGINEERS	2	0	0	2
ME1001	E	BASIC MECHANICAL ENGINEERING	2	0	0	2
EE1001	E	BASIC ELECTRICAL ENGINEERING	2	0	0	2
EC1001	E	BASIC ELECTRONICS ENGINEERING	2	0	0	2
ME1004	E	WORKSHOP PRACTICE	0	0	3	2
ME1005	E	ENGINEERING GRAPHICS	0	1	4	3
EC1002	E	ELECTRONICS ENGINEERING PRACTICES	0	0	2	1
EE1002	E	ELECTRICAL ENGINEERING PRACTICES	0	0	2	1

NC1001/ NS1001/ SP1001/ YG1001	G	*NCC/NSS/NSO/YOGA	0	0	1	1

*NCC- National Cadet Corps
NSS-National Service Scheme
NSO-National Sports Organization (India)

SEMESTER III						
COURSE CODE	**CATEGORY**	**COURSE NAME**	**L**	**T**	**P**	**C**
LE1003/ LE1004/ LE1005/ LE1006/ LE1007	G	GERMAN LANGUAGE PHASE I / FRENCH LANGUAGE PHASE I/ JAPANESE LANGUAGE PHASE I / KOREAN LANGUAGE PHASE I / CHINESE LANGUAGE PHASE I	2	0	0	2
PD1003	G	APTITUDE I	1	0	1	1
MA1033	B	MATHEMATICS FOR BIOMEDICAL ENGINEERING	4	0	0	4
BM1003	P	BASICS OF HUMAN ANATOMY AND PHYSIOLOGY	3	0	0	3
EC1007	P	DIGITAL SYSTEMS	3	0	0	3
EC1012	P	ELECTRONIC CIRCUITS	3	0	0	3
BM1006	P	BIOMEDICAL SENSORS AND MEASUREMENT DEVICES	3	0	0	3
BM1007	P	BIOMATERIALS AND ARTIFICIAL ORGANS	3	0	0	3
EC1010	P	DIGITAL SYSTEMS LAB	0	0	3	2
BM1009	P	APPLIED ELECTRONIC CIRCUITS LAB	0	0	2	1
BM1010	P	BIOMEDICAL SENSORS AND MEASUREMENT DEVICES LAB	0	0	2	1
		TOTAL	**22**	**0**	**8**	**26**
		Total Contact Hours	**30**			

SEMESTER IV						
COURSE CODE	**CATEGORY**	**COURSE NAME**	**L**	**T**	**P**	**C**
LE1008/ LE1009/ LE1010/ LE1011/ LE1012	G	GERMAN LANGUAGE PHASE II / FRENCH LANGUAGE PHASE II/ JAPANESE LANGUAGE PHASE II / KOREAN LANGUAGE PHASE II / CHINESE LANGUAGE PHASE II	2	0	0	2
PD1004	G	APTITUDE II	1	0	1	1
MA1044	B	NUMERICAL METHODS IN BIOMEDICAL ENGINEERING	4	0	0	4
BM1011	P	MEDICAL INSTRUMENTATION-I	3	0	0	3
BM1012	P	BIOMEDICAL CIRCUITS AND NETWORKS	3	1	0	4
BM1013	P	LINEAR INTEGRATED CIRCUITS	3	0	0	3
BM1014	P	FUNDAMENTALS OF SIGNALS AND SYSTEMS	3	1	0	4
BM11XX	P	Dep. Elective-I	3	0	0	3
BM1015	P	MEDICAL INSTRUMENTATION-I LAB	0	0	2	1
BM1016	P	BIOMEDICAL CIRCUITS AND NETWORKS LAB	0	0	2	1
BM1017	P	LINEAR INTEGRATED CIRCUITS LAB	0	0	2	1
		TOTAL	**22**	**2**	**7**	**27**
		Total Contact Hours	**31**			

SEMESTER V						
COURSE CODE	**CATEGORY**	**COURSE NAME**	**L**	**T**	**P**	**C**
PD1005	G	APTITUDE III	1	0	1	1
MA1035	B	MATHEMATICS FOR MEDICAL IMAGING	4	0	0	4
BM1018	P	BIOMEDICAL SIGNAL PROCESSING	3	1	0	4
BM1019	P	MEDICAL INSTRUMENTATION-II	3	0	0	3
BM1020	P	MEDICAL IMAGING SYSTEMS	3	0	0	3
BM1021	P	BIOMEDICAL SIGNAL PROCESSING LAB	0	0	2	1
BM1022	P	MEDICAL INSTRUMENTATION-II LAB	0	0	2	1

BM1047	P	INDUSTRIAL TRAINING-I (Training to be undergone after IV semester)	0	0	1	1
BM11XX	P	Dep. Elective-II	**3**	**0**	**0**	**3**
	P	Open Elective-I	**3**	**0**	**0**	**3**
		TOTAL	**20**	**1**	**6**	**24**
		Total Contact Hours	**27**			

SEMESTER VI						
COURSE CODE	**CATEGORY**	**COURSE NAME**	**L**	**T**	**P**	**C**
PD1006	G	APTITUDE IV	1	0	1	1
BM1023	P	MEDICAL IMAGE PROCESSING AND ANALYSIS	3	1	0	4
BM1024	P	MICROPROCESSOR AND MICROCONTROLLER BASED BIOMEDICAL INSTRUMENTATION	3	0	0	3
BM1029	P	REHABILITATION ENGINEERING	3	0	0	3
BM1025	P	MEDICAL IMAGE PROCESSING AND ANALYSIS LAB	0	0	2	1
BM1026	P	MICROPROCESSOR AND MICROCONTROLLER BASED BIOMEDICAL INSTRUMENTATION LAB	0	0	2	1
BM1049	P	MINOR PROJECT	0	0	2	1
BM11XX	P	Dep. Elective-III	3	0	0	3
	P	Open Elective-II	3	0	0	3
		TOTAL	**16**	**1**	**7**	**20**
		Total Contact Hours	**24**			

SEMESTER VII						
COURSE CODE	**CATEGORY**	**COURSE NAME**	**L**	**T**	**P**	**C**
BM1027	P	BIOMEDICAL CONTROL SYSTEMS	3	1	0	4
BM1028	P	VIRTUAL INSTRUMENTATION DESIGN FOR MEDICAL SYSTEMS	3	1	0	4
BM1030	P	BIOMEDICAL CONTROL SYSTEMS LAB	0	0	2	1
BM1031	P	VIRTUAL INSTRUMENTATION DESIGN FOR MEDICAL SYSTEMS LAB	0	0	2	1

BM1048	P	INDUSTRIAL TRAINING-II (Training to be undergone after VI semester)	0	0	1	1
BM11XX	P	Dep. Elective-IV	3	0	0	3
BM11XX	P	Dep. Elective-V	3	0	0	3
	P	Open Elective-III	3	0	0	3
		TOTAL	**15**	**2**	**5**	**20**
		Total Contact Hours	**21**			

SEMESTER VIII						
COURSE CODE	**CATEGORY**	**COURSE NAME**	**L**	**T**	**P**	**C**
BM1050	P	MAJOR PROJECT / PRACTICE SCHOOL	0	0	24	12
		TOTAL	**0**	**0**	**24**	**12**
		Total Contact Hours	**24**			

DEPARTMENTAL ELECTIVES

COURSE CODE	**CATEGORY**	**COURSE NAME**	**L**	**T**	**P**	**C**
I. BIOMEDICAL SERVICE ENGINEER						
BM1101	P	COMMUNICATION CIRCUITS AND SYSTEMS	3	0	0	3
BM1102	P	BIOMEDICAL LASER INSTRUMENTATION	3	0	0	3
BM1103	P	NUCLEAR MEDICINE	3	0	0	3
BM1104	P	RADIOTHERAPY EQUIPMENTS	3	0	0	3
BM1105	P	MEDICAL RADIATION SAFETY ENGINEERING	3	0	0	3
BM1106	P	QUALITY CONTROL AND REGULATORY ASPECTS IN MEDICAL DEVICES	3	0	0	3
BM1107	P	TROUBLESHOOTING OF MEDICAL INSTRUMENTS	3	0	0	3
II. APPLICATION SPECIALIST						
BM1108	P	HOSPITAL ENGINEERING	3	0	0	3
BM1109	P	TELEMEDICINE AND PICTURE	3	0	0	3

		ARCHIVAL COMMUNICATION SYSTEM (PACS)				
BM1110	P	ADVANCED MEDICAL IMAGING SYSTEMS	3	0	0	3
BM1111	P	ADVANCED DIAGNOSTIC AND SURGICAL EQUIPMENTS	3	0	0	3
BM1112	P	HOSPITAL RADIOPHARMACY	3	0	0	3
III. BIOMEDICAL ENTREPRENEUR						
BM1113	P	REGULATORY ASPECTS IN BIOSCIENCES	3	0	0	3
BM1114	P	HOME MEDICARE TECHNOLOGY	3	0	0	3
BM1115	P	DESIGN & DEVELOPMENT OF MEDICAL DEVICES	3	0	0	3
* The other two Courses can be taken suitably as open electives from the School of Business Management						
IV. RESEARCH & DEVELOPMENT ENGINEER						
BM1116	P	APPLIED OPTOELECTRONICS IN MEDICINE	3	0	0	3
BM1117	P	BIOMEDICAL MEMS AND NANOTECHNOLOGY	3	0	0	3
BM1118	P	APPLIED NEURAL NETWORKS AND FUZZY LOGIC IN MEDICINE	3	0	0	3
BM1119	P	ARTIFICIAL INTELLIGENCE AND PATTERN RECOGNITION IN MEDICINE	3	0	0	3
BM1120	P	BRAIN-COMPUTER INTERFACE	3	0	0	3
BM1121	P	ELECTRO PHYSIOLOGY OF HUMAN SYSTEM	3	0	0	3
V. HIGHER STUDIES						
BM1122	P	BIOPHOTONICS	3	0	0	3
BM1123	P	BIOMECHANICS	3	0	0	3
BM1124	P	COMPUTATIONAL FLUID DYNAMICS ANALYSIS IN MEDICINE	3	0	0	3
BM1125	P	PHYSIOLOGICAL MODELING	3	0	0	3
BM1126	P	ROBOTICS AND AUTOMATION IN MEDICINE	3	0	0	3

Summary of credits										
Category	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total**	**%**
G (Excluding open and departmental electives)	5	3	3	3	1	1			16	8.8
B (Excluding open and departmental electives)	12	11	4	4	4				35	19.2
E (Excluding open and departmental electives)	9	6							15	8.2
P (Excluding open and departmental electives)		7	19	17	13	13	11	12	92	50.5
Open Elective					3	3	3		9	5
Dep. Elective				3	3	3	6		15	8.2
Total	**26**	**27**	**26**	**27**	**24**	**20**	**20**	**12**	**182**	**100**

SEMESTER I

PD1001	**SOFT SKILLS I**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	**1**	**0**	**1**	**1**
	Prerequisite				
	Nil				

PURPOSE	
To enhance holistic development of students and improve their employability skills.	
INSTRUCTIONAL OBJECTIVES	
1.	To develop inter personal skills and be an effective goal oriented team player.
2.	To develop professionals with idealistic, practical and moral values.
3.	To develop communication and problem solving skills.
4.	To re-engineer attitude and understand its influence on behavior.

UNIT I - SELF ANALYSIS **(4 Hours)**

SWOT Analysis, Who am I, Attributes, Importance of Self Confidence, Self Esteem

UNIT II - ATTITUDE **(4 Hours)**

Factors influencing Attitude, Challenges and lessons from Attitude.

Change Management

Exploring Challenges, Risking Comfort Zone, Managing Change

UNIT III - MOTIVATION **(6 Hours)**

Factors of motivation, Self talk, Intrinsic & Extrinsic Motivators.

UNIT IV - GOAL SETTING **(6 Hours)**

Wish List, SMART Goals, Blue print for success, Short Term, Long Term, Life Time Goals.

Time Management

Value of time, Diagnosing Time Management, Weekly Planner To do list, Prioritizing work.

UNIT V - CREATIVITY **(10 Hours)**

Out of box thinking, Lateral Thinking

Presentation

ASSESSMENT

1. A practical and activity oriented course which has continuous assessment for 75 marks based on class room interaction, activities etc.
2. Presentation – 25 marks

TEXT BOOK

1. INSIGHT, 2009, "*Career Development Centre*", SRM Publications .

REFERENCES

1. Covey Sean, "*Seven Habits of Highly Effective Teens*", New York, Fireside Publishers, 1998.
2. Carnegie Dale, "*How to win Friends and Influence People*", New York: Simon & Schuster, 1998.
3. Thomas A Harris, "*I am ok, You are ok*" , New York-Harper and Row, 1972
4. Daniel Coleman, "*Emotional Intelligence*", Bantam Book, 2006

PD1001 SOFT SKILLS I												
Course designed by		**Career Development Centre**										
1	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
					X		**X**	**X**		**X**		
2	Mapping of instructional objectives with student outcome				**1**		**2**	**3**		**4**		
3	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
		X										
4	Approval	23rd meeting of Academic Council, May 2013										

MA1011	**MATRICES AND CALCULUS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 75 Hours	**3**	**2**	**0**	**4**
	(Common to BT, BI, BME, BP, GE, FPE)				
	Prerequisite				
	Nil				

Purpose

To impart analytical ability in solving mathematical problems as applied to the respective branches of Engineering.

Instructional objectives:

1.	To apply advanced matrix knowledge to Engineering problems.
2.	To improve their ability in trigonometry.
3.	To equip themselves familiar with the concepts of Differential calculus
4.	To expose to the concept of integral calculus
5.	To familiarize with the applications of differential and integral calculus

UNIT I - MATRICES **(12 Hours)**

*Review types of matrices, properties. Inverse matrix Cramer's rule for solving a system of linear equations. – Rank of Matrix – Consistency and Inconsistency of a system of m linear equations in 'n' unknowns –Cayley Hamilton theorem – Eigen values and Eigen vectors of a real matrix.

UNIT II -TRIGONOMETRY **(12 Hours)**

*****Review of complex numbers. De Moiver's theorem and its applications. Expansion of $\sin n\theta$, $\cos n\theta$ in terms of $\sin\theta$ *and* $\cos\theta$. Expansion of $\tan n\theta$ in terms of $\tan\theta$. Expansion of $\sin^n\theta$ *and* $\cos^n\theta$ in terms of sines and cosines of multiples of θ. Hyperbolic functions and inverse hyperbolic functions.

UNIT III - DIFFERENTIAL CALCULUS **(12 Hours)**

Differentiation and Derivatives of simple functions – Successive Differentiation – Various forms of Algebraic and Trigonometric functions – Problems.

UNIT IV - INTEGRAL CALCULUS **(12 Hours)**

Methods of integration – Definite integrals and its properties-Reduction formula for $e^{ax}x^n$, $\sin^n x$, $\cos^n x$, $\sin^n x\cos^m x$ (without proof)- Problems

UNIT V -APPLICATIONS OF DIFFERENTIAL CALCULUS & INTEGRAL CALCULUS

(12 Hours)

Applications of differential calculus & integral calculus. Tangent & Normal-Radius of curvature – Velocity and acceleration . Integral calculus - Length & Area.

TEXT BOOKS

1. Kreyszig.E, "*Advanced Engineering Mathematics"*, 10th edition, John Wiley & Sons. Singapore,2012.
2. Ganesan.K, Sundarammal Kesavan, Ganapathy Subramanian K.S & Srinivasan V, "*Engineering Mathematics"*, Revised Edition, 2013.

REFERENCES

1. Grewal B.S, "*Higher Engg Math"s*, Khanna Publications, 42nd Edition,2012.
2. Veerajan, T., "*Engineering Mathematics"* I, Tata McGraw Hill Publishing Co., New Delhi, 5th edition, 2006.
3. Kandasamy P etal. "*Engineering Mathematic"s*, Vol.I (4th revised edition), S.Chand &Co., New Delhi, 2000.

4. Narayanan S., Manicavachagom Pillay T.K., Ramanaiah G., *"Advanced Mathematics for Engineering students"*, Volume I (2nd edition), S.Viswanathan Printers and Publishers, 1992.
5. Venkataraman M.K., *"Engineering Mathematics"* – First Year (2nd edition), National Publishing Co., Chennai, 2000.

MA1011 MATRICES AND CALCULUS												
Course designed by		**Department of Mathematics**										
1	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		X				**X**						
2	Mapping of instructional objectives with student outcome	**1-5**				**1-5**						
3	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
		--		**X**			--			--		
4	Approval	23rd meeting of academic council, May 2013										

PY1001	**PHYSICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

The purpose of this course is to provide an understanding of physical concepts and underlying various engineering and technological applications. In addition, the course is expected to develop scientific temperament and analytical skill in students, to enable them logically tackle complex engineering problems in their chosen area of application.

INSTRUCTIONAL OBJECTIVES

1.	To understand the general scientific concepts required for technology
2.	To apply the Physics concepts in solving engineering problems
3.	To educate scientifically the new developments in engineering and technology
4.	To emphasize the significance of Green technology through Physics principles

UNIT I – MECHANICAL PROPERTIES OF SOLIDS AND ACOUSTICS

(9 Hours)

Mechanical properties of solids: Stress-strain relationship – Hooke's law – Torsional Pendulum – Young's modulus by cantilever – Uniform and non-uniform bending — Stress-strain diagram for various engineering materials – Ductile and brittle materials – Mechanical properties of Engineering materials (Tensile strength, Hardness, Fatigue, Impact strength, Creep) – Fracture – Types of fracture (Elementary ideas).

Acoustics: Intensity – Loudness – Absorption coefficient and its determination – Reverberation – Reverberation time – Factors affecting acoustics of buildings and their remedies – Sources and impacts of noise – Sound level meter – Strategies on controlling noise pollution – Ultrasonic waves and properties – Methods of Ultrasonic production (Magnetostriction and Piezoelectric) – Applications of Ultrasonics in Engineering and medicine.

UNIT II – ELECTROMAGNETIC WAVES, CIRCUITS AND APPLICATIONS

(9 Hours)

Del operator – grad, div, curl and their physical significances - displacement current – Maxwell's equations (derivation) – Wave equation for electromagnetic waves – Propagation in free space – Poynting theorem – Characteristic of Transverse electric and magnetic waves – Skin depth – Rectangular and circular waveguides – High powered vacuum-based cavity magnetrons – Applications including radars, microwave oven and lighting systems.

UNIT III – LASERS AND FIBER OPTICS (9 Hours)

Lasers: Characteristics of Lasers – Einstein's coefficients and their relations – Lasing action – Working principle and components of CO_2 Laser, Nd-YAG Laser, Semiconductor diode Laser, Excimer Laser and Free electron Laser – Applications in Remote sensing, holography and optical switching – Mechanism of Laser cooling and trapping.

Fiber Optics: Principle of Optical fiber – Acceptance angle and acceptance cone – Numerical aperture – V-number – Types of optical fibers (Material, Refractive index and mode) – Photonic crystal fibers – Fiber optic communication – Fiber optic sensors.

UNIT IV– QUANTUM MECHANICS AND CRYSTAL PHYSICS (9 Hours)

Quantum mechanics: Inadequacies of Classical Mechanics – Duality nature of electromagnetic radiation – De Broglie hypothesis for matter waves – Heisenberg's uncertainty principles –Schrödinger's wave equation – Particle confinement in 1D box (Infinite Square well potential). **Crystal Physics:** Crystal directions – Planes and Miller indices – Symmetry elements – Quasi crystals – Diamond and HCP crystal

structure – Packing factor – Reciprocal lattice – Diffraction of X-rays by crystal planes – Laue method and powder method – Imperfections in crystals.

UNIT V– GREEN ENERGY PHYSICS (9 Hours)

Introduction to Green energy – **Solar energy:** Energy conversion by photovoltaic principle – Solar cells – **Wind energy:** Basic components and principle of wind energy conversion systems – **Ocean energy:** Wave energy – Wave energy conversion devices – Tidal energy – single and double basin tidal power plants – Ocean Thermal Electric Conversion (OTEC) – **Geothermal energy:** Geothermal sources (hydrothermal, geo-pressurized hot dry rocks, magma) – **Biomass:** Biomass and bio-fuels – bio-energies from wastages – **Fuel cells**: H_2O_2 – **Futuristic Energy:** Hydrogen – Methane Hydrates – Carbon capture and storage (CCS).

* One problem sheet consisting of 10 to 15 problems is to be prepared for each unit and discussed in the class.
* Few problems based on design considerations related to appropriate branches of engineering can be incorporated in each problem sheet.

TEXT BOOKS

1. Thiruvadigal J.D., Ponnusamy S, Sudha D and Krishnamohan M, "Physics for Technologist", Vibrant Publication, Chennai, 2013.
2. Dattu R, Joshi, "Engineering Physics", Tata McGraw-Hill, New Delhi, 2010.

REFERENCES

1. Wole Soboyejo, "*Mechanical Properties of Engineered Materials*", Marcel Dekker Inc., 2003
2. Frank Fahy, "*Foundations of Engineering Acoustics*", Elsevier Academic Press, 2005
3. Alberto Sona, "*Lasers and their applications*", Gordon and Breach Science Publishers Ltd., 1976
4. David J. Griffiths, "*Introduction to electrodynamics*", 3rd ed., Prentice Hall, 1999
5. Leonard. I. Schiff, "*Quantum Mechanics"*, Third Edition, Tata McGraw Hill, 2010.
6. Charles Kittel, "*Introduction to Solid State Physics*", Wiley India Pvt. Ltd, 7th ed., 2007
7. Godfrey Boyle, "*Renewable Energy: Power sustainable future*", 2nd edition, Oxford University Press, UK, 2004

PY1001 PHYSICS												
Course designed by		Department of Physics and Nanotechnology										
1	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		x		**x**		**x**						
2	Mapping of instructional objectives with student outcome	**1**		**4**		**2**						
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)		
				x								
4	Approval	23rd meeting of Academic Council, May 2013										

PY1002	PHYSICS LABORATORY	L	T	P	C
	Total Contact Hours - 30	**0**	**0**	**2**	**1**
	Prerequisite				
	Nil				

PURPOSE

The purpose of this course is to develop scientific temper in experimental techniques and to reinforce the physics concepts among the engineering students

INSTRUCTIONAL OBJECTIVES

1.	To gain knowledge in the scientific methods and learn the process of measuring different Physical variables
2.	Develop the skills in arranging and handling different measuring instruments
3.	Get familiarized with experimental errors in various physical measurements and to plan / suggest on how the contributions could be made of the same order, so as to minimize the errors.

LIST OF EXPERIMENTS

1. Determination of Young's modulus of a given material – Uniform / Non-uniform bending methods.
2. Determination of Rigidity modulus of a given material – Torsion pendulum
3. Determination of dispersive power of a prism – Spectrometer
4. Determination of laser parameters – divergence and wavelength for a given laser source –laser grating/ Particle size determination using laser
5. Study of attenuation and propagation characteristics of optical fiber cable
6. Calibration of voltmeter / ammeter using potentiometer
7. Construction and study of IC regulation properties of a given power supply
8. Study of V-I and V-R characteristics of a solar cell

9. Mini Project – Concept based Demonstration

TEXT BOOKS

1. Thiruvadigal J.D., Ponnusamy S, Sudha D and Krishnamohan M, "Physics for Technologist", Vibrant Publication, Chennai, 2013.
2. Shukla R.K.and Anchal Srivastava, "*Practical Physics*", 1st Edition, New Age International (P) Ltd, New Delhi, 2006.

REFERENCES

1. Souires G.L., "*Practical Physics*:, 4th Edition, Cambridge University, UK, 2001.
2. Chattopadhyay D., Rakshit P. C. and Saha B, "*An Advanced Course in Practical Physics*", 2nd ed., Books & Allied Ltd., Calcutta, 1990

PY1002 PHYSICS LABORATORY												
Course designed by		**Department of Physics and Nanotechnology**										
1	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		x	**x**			**x**						
2	Mapping of instructional objectives with student outcome	**1**	**3**			**2**						
3	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
					x							
4	Approval	23rd meeting of Academic Council, May 2013										

CY1001	**CHEMISTRY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

To enable the students to acquire knowledge in the principles of chemistry for engineering applications

INSTRUCTIONAL OBJECTIVES

The students should be conversant with

1.	The quality of water and its treatment methods for domestic and industrial applications.

2.	The classification of polymers, different types of polymerizations, preparation, properties and applications of important polymers and FRPs.
3.	The phase rule and its application to one and two component systems.
4.	The principle, types and mechanism of corrosion and protective coatings.
5.	The classification and selection of lubricants and their applications.
6.	The basic principles, instrumentation and applications of analytical techniques

UNIT I - WATER TREATMENT (9Hours)

Water quality parameters: Physical, Chemical & Biological significance - Hardness of water - estimation of hardness (EDTA method) - Dissolved oxygen – determination (Winkler's method), Alkalinity - determination - disadvantages of using hard water in boilers: Scale, sludge formation - disadvantages - prevention - treatment: Internal conditioning - phosphate, calgon and carbonate conditioning methods - External: Zeolite, ion exchange methods - desalination - reverse osmosis and electrodialysis - domestic water treatment.

UNIT II - POLYMERS AND REINFORCED PLASTICS (9Hours)

Classification of polymers - types of polymerization reactions - mechanism of addition polymerization: free radical, ionic and Ziegler - Natta - effect of structure on the properties of polymers - strength, plastic deformation, elasticity and crystallinity - Preparation and properties of important resins: Polyethylene, PVC, PMMA, Polyester, Teflon, Bakelite and Epoxy resins - compounding of plastics - moulding methods - injection, extrusion, compression and calendaring - reinforced plastics - FRP – Carbon and Glass- applications.

UNIT III - PHASE EQUILIBRIA, LUBRICANTS AND ADHESIVES (9Hours)

Phase rule: Statement - explanation of the terms involved - one component system (water system only). Condensed phase rule - thermal analysis - two component systems: simple eutectic, Pb-Ag; compound formation, Zn-Mg.

Lubricants: Classification –solid, semi solid, liquid, emulsion- properties – selection of lubricants for different purposes, Adhesives: classification-natural, synthetic, inorganic-Adhesive action - applications.

UNIT IV - CORROSION AND ITS CONTROL (9Hours)

Corrosion: Basic concepts - mechanism of chemical, electrochemical corrosion - Pilling Bedworth rule – Types of Electrochemical corrosion - galvanic corrosion - differential aeration corrosion - pitting corrosion - stress corrosion – Measurement of corrosion (wt. loss method only) - factors influencing corrosion.

Corrosion control: Cathodic protection - sacrificial anodic method - corrosion inhibitors. Protective coatings: surface preparation for metallic coatings - electro plating (copper plating) and electroless plating (Nickel plating) - chemical conversion coatings - anodizing, phosphating & chromate coating.

UNIT V - INSTRUMENTAL METHODS OF ANALYSIS (9 Hours)

Basic principles, instrumentation and applications of potentiometry, UV - visible spectroscopy, infrared spectroscopy, atomic absorption spectroscopy and flame photometry .

TEXT BOOKS

1. Kamaraj.P & Arthanareeswari. M, *Applied Chemistry, 9th Edition*, Sudhandhira Publications, 2012.
2. Dara S.S, A Text book of Engineering Chemistry, 10th Edition, S.Chand & Company Ltd. , New Delhi, 2003

REFERENCES

1. Jain.P.C and Monika Jain, "*Engineering Chemistry*", Danpat Rai publishing company (P) Ltd, New Delhi, 2010.
2. Helen P Kavitha, *Engineering Chemistry - I, Scitech* Publications, 2nd edition, 2008.

CY1001 CHEMISTRY												
Course designed by		Department of Chemistry										
1	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
			x	x		x						
2	Mapping of instructional objectives with student outcome		1-6	3		2-5						
3	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
					x							
4	Approval	23rd meeting of Academic Council, May 2013										

CY1002	CHEMISTRY LABORATORY	L	T	P	C
	Total Contact Hours - 30	0	0	2	1
	Prerequisite				
	Nil				

PURPOSE

To apply the concepts of chemistry and develop analytical skills for applications in engineering.

INSTRUCTIONAL OBJECTIVES

1.	To enable the students to understand the basic concepts involved in the analyses.

LIST OF EXPERIMENTS

1. Preparation of standard solutions
2. Estimation of total, permanent and temporary hardness by EDTA method
3. Conductometric titration - determination of strength of an acid
4. Estimation of iron by potentiometry.
5. Determination of molecular weight of polymer by viscosity average method
6. Determination of dissolved oxygen in a water sample by Winkler's method
7. Determination of Na / K in water sample by Flame photometry (Demonstration)
8. Estimation of Copper in ore
9. Estimation of nickel in steel
10. Determination of total alkalinity and acidity of a water sample
11. Determination of rate of corrosion by weight loss method.

REFERENCES

1. Kamaraj & Arthanareeswari, Sudhandhira Publications, "*Practical Chemistry*" (work book), 2011.
2. Helen P. Kavitha, "*Chemistry Laboratory Manual*", Scitech Publications, 2008.

CY1002 CHEMISTRY LABORATORY												
Course designed by		Department of Chemistry										
1	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		X	**x**									**X**
2	Mapping of instructional objectives with student outcome	**1**	**1**									**1**

3	Category	General (G)	Basic Sciences (B)	Engineering Sciences and Technical Arts (E)	Professional Subjects (P)
			x		
4	Approval	23rd meeting of Academic Council, May 2013			

LE1002	**VALUE EDUCATION**	**L**	**T**	**P**	**C**
	Total contact Hours- 15	**1**	**0**	**0**	**1**
	Prerequisite				
	Nil				

PURPOSE

To provide guiding principles and tools for the development of the whole person recognizing that the individual is comprised of Physical, Intellectual, Emotional and Spiritual dimensions.

INSTRUCTIONAL OBJECTIVES

1.	To help individuals think about and reflect on different values.
2.	To deepen understanding, motivation and responsibility with regard to making personal and social choices and the practical implications of expressing them in relation to themselves, others, the community and the world at large
3.	To inspire individuals to choose their own personal, social, moral and spiritual values and be aware of practical methods for developing and deepening

UNIT I - INTRODUCTION (3 Hours)

Definition, Relevance, Types of values, changing concepts of values

UNIT II - INDIVIDUAL AND GROUP BEHAVIOUR (3 Hours)

Personal values – Self – Strengths (self-confidence, self-assessment, self-reliance, self-discipline, determination, self-restraint, contentment, humility, sympathy and compassion, gratitude, forgiveness)

Weaknesses (Influences -- Peer pressure, familial and societal expectations, media)

UNIT III - SOCIETIES IN PROGRESS (3 Hours)

Definition of society; Units of society; Communities – ancient and modern – Agents of change – Sense of survival, security, desire for comfort and ease sense of belonging, social consciousness and responsibility

UNIT IV - ENGINEERING ETHICS **(3 Hours)**

Definition - Societies for engineers – Code of Ethics – Ethical Issues involved in cross border research -- Ethical and Un ethical practices – case studies – situational decision making

UNIT V - SPIRITUAL VALUES **(3 Hours)**

What is religion? -- Role of religion – Misinterpretation of religion – moral policing – Consequences -- Religion as spiritual quest – Aesthetics and religion

TEXT BOOK

1. Department of English and Foreign Languages SRM University. Rhythm *of Life* **.** SRM University Publications, 2013.

REFERENCE

1. Values **(**Collection of Essays)., Published by : Sri Ramakrishna Math, Chennai-4. 1996.

LE1002 VALUE EDUCATION												
Course designed by		**Department of English and Foreign Languages**										
1	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
							X			**X**		
2	Mapping of instructional objectives with student outcome						**1-3**			**1-3**		
3	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
		x			**x**							
4	Approval	23rd meeting of Academic Council, May 2013										

CE1001	BASIC CIVIL ENGINEERING	L	T	P	C
	Total contact Hours- 30	2	0	0	2
	Prerequisite				
	Nil				

PURPOSE

To get exposed to the glimpses of Civil Engineering topics that is essential for an Engineer.

INSTRUCTIONAL OBJECTIVES

1.	To know about different materials and their properties
2.	To know about engineering aspects related to buildings
3.	To know about importance of surveying and the transportation systems
4.	To get exposed to the rudiments of engineering related to dams, water supply, and sewage disposal

UNIT I - BUILDING MATERIALS (6 Hours)

Introduction – Civil Engineering – Materials: Bricks – composition – classifications – properties –uses. Stone – classification of rocks – quarrying – dressing –properties – uses. Timber - properties –uses –ply wood. Cement – grades –types – properties – uses. Steel – types – mild steel – medium steel – hard steel – properties – uses – market forms. Concrete – grade designation – properties – uses.

UNIT II - MATERIAL PROPERTIES (6 Hours)

Stress – strain – types – Hook's law – three moduli of elasticity – poisons ratio – relationship – factor of safety. Centroid - center of gravity – problems in symmetrical sections only (I, T and channel sections). Moment of inertia, parallel, perpendicular axis theorems and radius of gyration (definitions only).

UNIT III - BUILDING COMPONENTS (6 Hours)

Building – selection of site – classification – components. Foundations –functions – classifications – bearing capacity. Flooring – requirements – selection – types – cement concrete marble – terrazzo floorings. Roof – types and requirements.

UNIT IV - SURVEYING AND TRANSPORTATION (6 Hours)

Surveying – objectives – classification – principles of survey. Transportation – classification – cross section and components of road – classification of roads. Railway – cross section and components of permanent way –functions. Water way – docks and harbor – classifications – components. Bridge – components of bridge.

UNIT V - WATER SUPPLY AND SEWAGE DISPOSAL (6 Hours)

Dams – purpose – selection of site – types –gravity dam (cross section only). Water supply – objective – quantity of water – sources – standards of drinking water – distribution system. Sewage – classification – technical terms – septic tank – components and functions.

TEXT BOOKS

1. Raju K.V.B., Ravichandran P.T., "*Basics of Civil Engineering*", Ayyappa Publications, Chennai, 2012
2. Rangwala,S.C.,"*Engineering Material"s*, Charotar Publishing House, Anand, 2012

REFERENCES

1. Ramesh Babu, "*Civil Engineerin"g* , VRB Publishers, Chennai, 2000
2. National Building Code of India, Part V, "*Building Materials"*, 2005
3. Surendra Singh, "*Building Material"s*, Vikas Publishing Company, New Delhi, 1996

CE1001 BASIC CIVIL ENGINEERING												
Course designed by		**Department of Civil Engineering**										
1	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		x				**x**						**x**
2	Mapping of instructional objectives with student outcome	**1-4**				**1-4**						**2-4**
3	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
							x					
4	Approval	23rd meeting of Academic Council, May 2013										

SEMESTER II

PD1002	**SOFT SKILLS -II**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	**1**	**0**	**1**	**1**
	Prerequisite				
	Nil				

PURPOSE	
To enhance holistic development of students and improve their employability skills.	
INSTRUCTIONAL OBJECTIVES	
1.	To develop inter personal skills and be an effective goal oriented team player.
2.	To develop professionals with idealistic, practical and moral values.
3.	To develop communication and problem solving skills.
4.	To re-engineer attitude and understand its influence on behavior.

UNIT I - INTERPERSONAL SKILLS (6 Hours)

Understanding the relationship between Leadership Networking & Team work, Realizing Ones Skills in Leadership, Networking & Team Work, and Assessing Interpersonal Skills Situation description of Interpersonal Skill.

Team Work

Necessity of Team Work Personally, Socially and Educationally

UNIT II - LEADERSHIP (4 Hours)

Skills for a good Leader, Assessment of Leadership Skills

Change Management

Exploring Challenges, Risking Comfort Zone, Managing Change

UNIT III - STRESS MANAGEMENT (6 Hours)

Causes of Stress and its impact, how to manage & distress, Understanding the circle of control, Stress Busters.

Emotional Intelligence

What is Emotional Intelligence, emotional quotient why Emotional Intelligence matters, Emotion Scales. Managing Emotions.

UNIT IV - CONFLICT RESOLUTION (4 Hours)

Conflicts in Human Relations – Reasons Case Studies, Approaches to conflict resolution.

UNIT V - DECISION MAKING (10 Hours)

Importance and necessity of Decision Making, process of Decision Making, Practical way of Decision Making, Weighing Positives & Negatives.

Presentation

ASSESSMENT

1. A practical and activity oriented course which has a continuous assessment for 75 marks based on class room interaction, activities etc.,
2. Presentation - 25 marks

TEXT BOOK

1. INSIGHT, 2009. Career Development Centre, SRM Publications

REFERENCES

1. Covey Sean, "*Seven Habit of Highly Effective Teens"*, New York, Fireside Publishers, 1998.
2. Carnegie Dale, "*How to win Friends and Influence People"*, New York: Simon & Schuster, 1998.
3. Thomas A Harris, "*I am ok, You are ok"* , New York-Harper and Row, 1972
4. Daniel Coleman, "*Emotional Intelligence"*, Bantam Book, 2006

PD1002- SOFT SKILLS- II												
Course designed by		**Career Development Centre**										
1	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
					X		**X**	**X**		**X**		
2	Mapping of instructional objectives with student outcome				**1**		**2**	**3**		**4**		
3	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
		x					**x**					
4	Approval	23rd meeting of Academic Council, May 2013										

MA1012	**MULTIPLE INTEGRALS AND DIFFERENTIAL EQUATIONS**	**L**	**T**	**P**	**C**
	Total No. of Contact Hours – 75 Hours	**3**	**2**	**0**	**4**
	(Common to Bio group)				
	Prerequisite				
	Nil				

Purpose:

To impart analytical ability in solving mathematical problems as applied to the respective branches of Engineering.

Instructional objectives:

1.	To understand maxima and minima of two and three variables.
2.	To expose to the concepts of Differential equations
3.	To expose to the concepts of Multiple integrals.
4.	To expose to the concept of vector calculus
5.	To expose to the concept of three dimensional analytical geometry.

UNIT I - FUNCTIONS OF SEVERAL VARIABLES (12 Hours)

Functions of two variables – partial derivatives – total differentiation – Taylor's expansion – maxima and minima of functions of two and three variables - Jacobians.

UNIT II - DIFFERENTIAL EQUATIONS (12 Hours)

Differential equations of first order – Linear equations of second order with constant coefficients and variable coefficients – method of variation of parameters.

UNIT III - MULTIPLE INTEGRALS (12 Hours)

Double integration in Cartesian and polar coordinates – Change of order of integration – Triple integration in Cartesian coordinates.

UNIT IV - VECTOR CALCULUS (12 Hours)

*Review of Vector Algebra. Gradient, divergence and curl – solenoidal, and irrotational fields – directional derivatives – line integrals – surface integrals – volume integrals, Integral theorems (without proof) and its applications**-** cubes and parallelepipeds only

UNIT V - THREE DIMENSIONAL ANALYTICAL GEOMETRY (12 Hours)

Direction cosines and direction ratios of a line – angle between two lines. Equation of a plane – equation of straight line – shortest distance between two skew lines – coplanar lines.

TEXT BOOKS

1. Kreyszig.E, Advanced "*Engineering Mathematics"*, 10th edition, John Wiley & Sons. Singapore, 2012.
2. K.Ganesan, Sundarammal Kesavan, K.S.Ganapathy Subramanian & V.Srinivasan, "*Engineering Mathematic"s*, Revised Edition, 2013.

REFERENCES

1. Grewal B.S, Higher "*Engineering Mathematics"*, Khanna Publications, 42nd Edition,2012.
2. Veerajan, T., "*Engineering Mathematics"* I, Tata McGraw Hill Publishing Co., New Delhi, 5th edition, 2006.
3. Kandasamy P etal. "*Engineering Mathematics"*, Vol.I (4th revised edition), S.Chand &Co., New Delhi,2000.
4. Narayanan S., Manicavachagom Pillay T.K., Ramanaiah G., Advanced "*Mathematics for Engineering students"*, Volume I (2nd edition), S.Viswanathan Printers and Publishers, 1992.
5. Venkataraman M.K., "*Engineering Mathematics"* – First Year (2nd edition), National Publishing Co., Chennai, 2000.

<table>
<tr><th colspan="14">MA1012 MULTIPLE INTEGRALS AND DIFFERENTIAL EQUATIONS</th></tr>
<tr><td colspan="2">Course designed by</td><td colspan="12">Department of Mathematics</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Student Outcome</td><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td>g</td><td>h</td><td>i</td><td>j</td><td>k</td></tr>
<tr><td>X</td><td></td><td></td><td></td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2</td><td>Mapping of instructional objectives with student outcome</td><td>1-5</td><td></td><td></td><td></td><td>1-5</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Category</td><td colspan="3">General (G)</td><td colspan="2">Basic Sciences (B)</td><td colspan="3">Engineering Sciences and Technical Arts (E)</td><td colspan="3">Professional Subjects (P)</td></tr>
<tr><td colspan="3"></td><td colspan="2">X</td><td colspan="3"></td><td colspan="3"></td></tr>
<tr><td>4</td><td>Approval</td><td colspan="12">23rd meeting of Academic Council, May 2013</td></tr>
</table>

PY1003	MATERIAL SCIENCE	L	T	P	C
	Total Contact Hours - 60	2	0	2	3
	Prerequisite				
	Nil				

PURPOSE

The course introduces several advanced concepts and topics in the rapidly evolving field of material science. Students are expected to develop comprehension of the subject and to gain scientific understanding regarding the choice and manipulation of materials for desired engineering applications.

INSTRUCTIONAL OBJECTIVES

1.	To acquire basic understanding of advanced materials, their functions and properties for technological applications
2.	To emphasize the significance of materials selection in the design process
3.	To understand the principal classes of bio-materials and their functionalities in modern medical science
4.	To get familiarize with the new concepts of Nano Science and Technology
5.	To educate the students in the basics of instrumentation, measurement, data acquisition, interpretation and analysis

UNIT I – ELECTRONIC AND PHOTONIC MATERIALS (6 Hours)

Electronic Materials: Fermi energy and Fermi–Dirac distribution function – Variation of Fermi level with temperature in intrinsic and extrinsic semiconductors – Hall effect – Dilute Magnetic Semiconductors (DMS) and their applications

Superconducting Materials: Normal and High temperature superconductivity – Applications.

Photonic Materials: LED – LCD – Photo conducting materials – Photo detectors (CCD) – Photonic crystals and applications – Elementary ideas of Non-linear optical materials and their applications.

UNIT II – MAGNETIC AND DIELECTRIC MATERIALS (6 Hours)

Magnetic Materials: Classification of magnetic materials based on spin – Hard and soft magnetic materials – Ferrites, garnets and magnetoplumbites – Magnetic bubbles and their applications – Magnetic thin films – Spintronics and devices (Giant magneto resistance, Tunnel magneto resistance and Colossal magneto resistance).

Dielectric Materials: Polarization mechanisms in dielectrics – Frequency and temperature dependence of polarization mechanism – Dielectric loss – Dielectric waveguide and dielectric resonator antenna – Piezoelectric, pyroelectric and ferroelectric materials and their applications.

UNIT III – MODERN ENGINEERING AND BIOMATERIALS (6 Hours)

Modern Engineering Materials: Smart materials – Shape memory alloys – Chromic materials (Thermo, Photo and Electro) – Rheological fluids – Metallic glasses – Advanced ceramics – Composites.

Bio-materials: Classification of bio-materials (based on tissue response) – Comparison of properties of some common biomaterials – Metallic implant materials (stainless steel, cobalt-based and titanium-based alloys) – Polymeric implant materials (Polyamides, polypropylene, Acrylic resins and Hydrogels) – Tissue replacement implants – Soft and hard tissue replacements – Skin implants – Tissue engineering – Biomaterials for organ replacement (Bone substitutes) – Biosensor.

UNIT IV – INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY (6 Hours)

Basic concepts of Nanoscience and Nanotechnology – Quantum wire – Quantum well – Quantum dot – fullerenes – Graphene – Carbon nanotubes – Material processing by chemical vapor deposition and physical vapor deposition – Principle of SEM, TEM, AFM, Scanning near-field optical microscopy (SNOM) – Scanning ion-conducting microscopy (SCIM) – Potential uses of nanomaterials in electronics, robotics, computers, sensors, sports equipment, mobile electronic devices, vehicles and transportation – Medical applications of nanomaterials.

UNIT V – MATERIALS CHARACTERIZATION (6 Hours)

X-ray diffraction, Neutron diffraction and Electron diffraction– X-ray fluorescence spectroscopy – Fourier transform Infrared spectroscopy (FTIR) – Ultraviolet and visible spectroscopy (UV-vis) – Thermogravimetric Analysis (TGA) – Differential Thermal Analysis (DTA) – Differential Scanning Calorimetry (DSC).

PRACTICAL EXPERIMENTS (30 Hours)

1. Determination of resistivity and band gap for a semiconductor material – Four probe method / Post-office box
2. Determination of Hall coefficient for a semiconducting material
3. To study V-I characteristics of a light dependent resistor (LDR)
4. Determination of energy loss in a magnetic material – B-H curve
5. Determination of paramagnetic susceptibility – Quincke's method
6. Determination of dielectric constant for a given material
7. Calculation of lattice cell parameters – X-ray diffraction
8. Measurement of glucose concentration – Electrochemical sensor
9. Visit to Advanced Material Characterization Laboratory (Optional)

TEXT BOOKS

1. Thiruvadigal J. D, PonnusamyS, SudhaD, and Krishnamohan M, "*Materials Sciences"*, Vibrant Publication, Chennai, 2013.
2. RajendranV, "*Materials Science*",Tata McGraw- Hill,New Delhi,2011.

REFERENCES

1. Rolf E. Hummel, "*Electronic Properties of Materials"*, 4th ed., Springer, New York, 2011.
2. Dennis W. Prather, "*Photonic Crystals: Theory, Applications, and Fabrication"*, John Wiley & Sons, Hoboken, 2009.
3. James R. Janesick, "*Scientific Charge-Coupled Devices",* Published by SPIE - The International Society for Optical Engineering, Bellingham, Washington, 2001.
4. David M. Pozar, "*Microwave Engineering*", 3rd ed., John Wiley & Sons, 2005.
5. SilverF, and DillionC, "*Biocompatibility: Interactions of Biological and Implantable Materials*", VCH Publishers, New York, 1989.
6. Severial Dumitriu, "*Polymeric Biomaterials*" Marcel Dekker Inc, CRC Press, Canada 2001.
7. CaoG, "*Nanostructures and Nanomaterials: Synthesis, Properties and Applications*", Imperial College Press, 2004.
8. PradeepT, "*A Text Book of Nanoscience and Nanotechnology*", Tata McGraw Hill, New Delhi, 2012.
9. Sam Zhang, "*Materials Characterization Techniques*", CRC Press, 2008.

PY1003 MATERIAL SCIENCE												
Course designed by		**Department of Physics and Nanotechnology**										
1	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		X	**X**		**X**	**X**						**X**
2	Mapping of instructional objectives with student outcome	**1**	**5**		**4**	**2**						**3**
3	Category	General (G)			Basic Sciences (B)			Engineering Sciences and Technical Arts (E)			Professional Subjects (P)	
					X							
4	Approval	23rd meeting of Academic Council, May 2013										

CY1003	PRINCIPLES OF ENVIRONMENTAL SCIENCE	L	T	P	C
	Total Contact Hours - 30	2	0	0	2
	Prerequisite				
	Nil				

PURPOSE

The course provides a comprehensive knowledge in environmental science, environmental issues and the management.

INSTRUCTIONAL OBJECTIVES

To enable the students

1.	To gain knowledge on the importance of environmental education and ecosystem.
2.	To acquire knowledge about environmental pollution- sources, effects and control measures of environmental pollution.
3.	To understand the treatment of wastewater and solid waste management.
4.	To acquire knowledge with respect to biodiversity, its threats and its conservation and appreciate the concept of interdependence.
5.	To be aware of the national and international concern for environment for protecting the environment

UNIT I - ENVIRONMENTAL EDUCATION AND ECOSYSTEMS (6 Hours)

Environmental education: Definition and objective. Structure and function of an ecosystem – ecological succession –primary and secondary succession - ecological pyramids – pyramid of number, pyramid of energy and pyramid of biomass.

UNIT II - ENVIRONMENTAL POLLUTION (6 Hours)

Environmental segments – structure and composition of atmosphere - Pollution – Air, water, soil , thermal and radiation – Effects – acid rain, ozone layer depletion and green house effect – control measures – determination of BOD, COD, TDS and trace metals.

UNIT III - WASTE MANAGEMENT (6 Hours)

Waste water treatment (general) – primary, secondary and tertiary stages.
Solid waste management: sources and effects of municipal waste, bio medical waste - process of waste management.

UNIT IV - BIODIVERSITY AND ITS CONSERVATION (6 Hours)

Introduction: definition - genetic, species and ecosystem diversity – bio diversity hot spots - values of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - threats to biodiversity: habitat loss, poaching of wildlife –

endangered and endemic species of India, Conservation of biodiversity: in-situ and ex-situ conservations.

UNIT V - ENVIRONMENTAL PROTECTION (6 Hours)

National concern for environment: Important environmental protection acts in India – water, air (prevention and control of pollution) act, wild life conservation and forest act – functions of central and state pollution control boards - international effort – key initiatives of Rio declaration, Vienna convention, Kyoto protocol and Johannesburg summit.

TEXT BOOKS

1. Kamaraj.P & Arthanareeswari.M, "*Environmental Science – Challenges and Changes*", 4th Edition, Sudhandhira Publications, 2010.
2. Sharma.B.K. and Kaur, "*Environmental Chemistry",* Goel Publishing House, Meerut, 1994.

REFERENCES

1. De.A.K., "*Environmental Chemistry*", New Age International, New Delhi, 1996.
2. Helen P Kavitha, Principles of Environmental Science, Sci tech Publications, 2nd Edition, 2008.

CY1003 PRINCIPLES OF ENVIRONMENTAL SCIENCE												
Course designed by		**Department of Chemistry**										
1	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
				X		**X**	**X**		**X**	**X**	**X**	
2	Mapping of instructional objectives with student outcome			**5**		**2**	**4**		**1,3**	**3**	**2, 5**	
3	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
					X							
4	Approval	23rd meeting of Academic Council, May 2013										

LE1001	ENGLISH	L	T	P	C
	Total contact Hours -45	1	2	0	2
	Prerequisite				
	Nil				

PURPOSE

To help students achieve proficiency in English and develop their professional communication skills to meet the demand in the field of global communication to enable them to acquire placement anywhere with ease and confidence.

INSTRUCTIONAL OBJECTIVES

1.	To enable students improve their lexical, grammatical and communicative competence.
2.	To enhance their communicative skills in real life situations.
3	To assist students understand the role of thinking in all forms of communication.
4.	To equip students with oral and appropriate written communication skills.
5.	To assist students with employability and job search skills.

UNIT I - INVENTIONS **(9 Hours)**

1. Grammar and Vocabulary – Tense and Concord:
2. Listening and Speaking – Common errors in Pronunciation (Individual sounds); Process description (Describing the working of a machine, and the manufacturing process)
3. Writing – Interpretation of data (Flow chart, Bar chart)
4. Reading -- (Reading Comprehension -- Answering questions)

UNIT II - ECOLOGY **(9 Hours)**

1. Grammar and Vocabulary – Error Analysis – Synonyms and Antonyms, Parallelisms
2. Listening and Speaking - Conducting Meetings
3. Writing – Notice, Agenda, Minutes , letters to the editor via email : Email etiquette
4. D Reading Comprehension – Summarizing and Note-making

UNIT III - SPACE **(9 Hours)**

1. Grammar and Vocabulary – tense and concord; word formation
2. Listening and Speaking – Distinction between native and Indian English (Speeches by TED and Kalam) – accent, use of vocabulary and rendering;
3. Writing – Definitions and Essay writing
4. Reading Comprehension – Predicting the content

UNIT IV - CAREERS **(9 Hours)**

1. Grammar and Vocabulary –Homonyms and Homophones
2. Listening and Speaking – – Group Discussion
3. Writing .Applying for job, cover letter and resume
4. Reading, etymology (roots; idioms and phrases), Appreciation of creative writing.

UNIT V - RESEARCH **(9 Hours)**

1. Grammar and Vocabulary – Using technical terms, Analogies
2. Listening and Speaking -- Presentation techniques (Speech by the learner)
3. Writing – Project Proposal
4. Reading Comprehension -- Referencing Skills for Academic Report Writing (Research Methodology – Various methods of collecting data) Writing a report based on MLA Handbook

TEXT BOOK

1. Department of English and Foreign Languages "*English for Engineers"*, SRM University Publications, 2013.

REFERENCES

1. Dhanavel, S.P. "*English and Communication Skills for Students of Science and Engineering".* Units 1-5. Chennai: Orient Blackswan Ltd., 2009.
2. Meenakshi Raman and Sangeetha Sharama**,** "Technical Communication-Principles and Practice"; - Oxford University Press, 2009.
3. Day, R A. "*Scientific English: A Guide for Scientists and Other Professionals".* 2nd ed. Hyderabad: Universities Press, 2000.

LE1001 ENGLISH												
Course designed by		**Department of English and Foreign Languages**										
1	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
								x				
2	Mapping of instructional objectives with student outcome							**1-5**				
3	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)				Professional Subjects (P)	
		x										
4	Approval	23rd meeting of Academic Council, May 2013										

BT1004	BIOCHEMISTRY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To provide an understanding of the functions of various biomolecules and their metabolism.

INSTRUCTIONAL OBJECTIVES

1.	To study structural and functional properties of carbohydrates, proteins, lipids and nucleic acids
2.	To emphasize the role of these biomolecules by providing basic information on specific metabolic diseases and disorders of these biomolecules

UNIT I - INTRODUCTION TO BIOCHEMISTRY (12 Hours)

Introduction-Chemical Bonds-pH-Buffers-Carbohydrates-Lipids-Proteins

UNIT II - METABOLISM OF CARBOHYDRATES (8 Hours)

Introduction to Metabolism-Glycolysis-Citric acid cycle-Gluconeogenesis-Glycogen metabolism-Glycogenesis-Glycogenolysis-Biochemical aspects of Diabetes Mellitus

UNIT III - PROTEIN METABOLISM (9 Hours)

Introduction-Metabolism of amino acids-Transamination-Deamination-Metabolism of ammonia-Urea cycle-Biosynthesis of amino acids-Disorders of tyrosine (phenylalanine) metabolism

UNIT IV - FATTY ACID METABOLISM AND NUCLEIC ACID METABOLIS (8 Hours)

Introduction-Fatty acid oxidation-Ketone bodies & Ketogenesis-Biosynthesis of Fatty acids-Eicosanoids-Cholesterol Biosynthesis-Lipoproteins-Disorders of Lipid metabolism-Nucleic acids: Biosynthesis of Purine and Pyrimidines-Degradation of purine nucleotides and pyrimidine nucleotides-Disorders of Purine and pyrimidine metabolism

UNIT V - OXIDATIVE PHOSPHORYLATION (8 Hours)

Introduction-Bioenergetics, High energy compounds, Biological oxidation-Electron transport chain, Oxidative phospholyration, Chemiosmotic theory-Shuttle pathway – Glycerol phosphate Shuttle, Malate aspartate Shuttle –Shunt pathways

REFERENCES

1. Jain, J L, Jain, Nitin, Sunjay Jain, "*Fundamentals of Biochemistry*," S. Chand Group, ISBN: 8121924537
2. U.Satyanarayana & U. Chakrapani, "*Biochemistry*,"Books And Allied (p) Ltd., ISBN: 8187134801
3. David L. Nelson, Albert Lester Lehninger, Michael M. Cox, "*Lehninger Principles of Biochemistry*," Edition 5, illustrated, W. H. Freeman, 2008
4. Jeremy M. Berg, John L. Tymoczko, Lubert Stryer, "*Biochemistry*," Edition 7, W. H. Freeman, 2012

BT1004 BIOCHEMISTRY												
Course designed by		**Department of Biotechnology**										
1	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		X			**X**							
2	Mapping of instructional objectives with student outcome	**1**			**2**							
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)		
										x		
4	Broad Area (for courses under 'P' only)	Biotechnology			Bioprocess Engineering			Chemical Engineering				
					--			--			--	
5	Approval	23rd meeting of Academic Council, May 2013										

BM1001	**MEDICAL ELECTRONIC DEVICES**	**L**	**T**	**P**	**C**
	Total contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

To introduce the basics of various electronic components used for the construction of medical devices.

INSTRUCTIONAL OBJECTIVES

1	To make them understand the basics of semiconductor diode.
2	To impart knowledge about various special purpose diodes.
3	To describe the characteristics of various transistor configuration.
4	To provide an in-depth knowledge of various field effect transistors.
5	To educate concepts of IC fabrication technique.

UNIT I - INTRODUCTION TO SEMICONDUCTOR DIODES (9 Hours)

p-n junction Energy band diagram of PN diode, PN diode operation- forward bias and reverse bias , Volt-ampere characteristics of p-n diode, Temperature dependence of VI characteristics, current components in p-n diode, Diode equation, Transition and Diffusion capacitances, Breakdown Mechanisms in Semi Conductor diodes

UNIT II - SPECIAL PURPOSE DIODES & TRANSISTORS (8 Hours)

Zener diode characteristics, Characteristics of Tunnel Diode, LED, LDR, Varactor Diode, photo diode, PIN diode, Medical Application of LED & PIN Photodiode, LASER diode, Junction transistor-construction, Transistor current components.

UNIT III - TRANSISTORS-CHARACTERISTICS, HYBRID MODEL (10 Hours)

Input and Output characteristics-Common Base, Common Emitter, Common Collector, Evaluation of H-parameters, Transistor hybrid model for CE configuration, Analysis of a Transistor Amplifier circuit using h-parameter, Transistor as a switch, Eber's Moll model of a BJT, Opto-coupler & its medical application.

UNIT IV- FIELD EFFECT TRANSISTOR (FET) (10 Hours)

Junction field effect transistor-Theory & its V-I Characteristics, JFET small signal model, VVR operation of a FET, MOSFET and its classification, V-I Characteristics, Power MOSFET, MOS as a charge transferring Device – CCD, Uni-junction transistor, UJT as a relaxation oscillator. Medical application of MOSFET

UNIT V- THYRISTORS AND IC FABRICATION (8 Hours)

Working, V-I characteristics and features of Silicon Controlled Rectifier, DIAC, TRIAC, GTO – Device Technology, Basic Planar processes, Thick film and thin film Technology.

TEXT BOOKS

1. Robert L. Boylestad, Louis Nashelsky, "*Electronic Devices and Circuit Theory*", Prentice Hall, Sixth edition, 2009.
2. David A.Bell, " *Electron Devices and Circuits*", Prentice Hall Of India, Fifth edition, 2007.
3. Millman and Halkias, "*Electronic devices and Circuits*", Tata McGraw Hill, First edition, 1994

REFERENCES

1. Dharmaraj Cheruku, Battula Thirumala Krishna, "*Electronic Devices and Circuits*", Pearson Education, Second Edition, 2008.

2. Thomas L. Floyd, "*Electron Devices* ", Charles & Messil Publications, Tenth edition 2009
3. R.S.Khandpur**,** "*Handbook of Biomedical Instrumentation*", Tata McGraw-Hill, Second edition, 2003

BM1001 MEDICAL ELECTRONIC DEVICES												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		X	**X**									
2	Mapping of instructional objectives with student outcome	**1**	**2**									
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)			
									X			
4	Broad area (for 'P'category)	Biomedical Electronics Engg		Basics of Biomedical Engg		Biomedical Instrumentation Engg			Biomedical Imaging Engg		Health care Engg	
		X										
5	Approval	23rd meeting of Academic Council, May 2013										

BM1002	**MEDICAL ELECTRONIC DEVICES LAB**	**L**	**T**	**P**	**C**
	Total contact Hours – 30	**0**	**0**	**2**	**1**
	Prerequisite				
	Nil				

PURPOSE

To study and analyze the theoretical and practical characteristics of the fundamental electronic devices

INSTRUCTIONAL OBJECTIVES

1.	To study the characteristics of diodes, transistors, FET and special purpose
2.	To analyze the applicability of the basic devices in various bio-medical applications

LIST OF EXPERIMENTS

1. Characteristics of semiconductor Diode
2. Characteristics of Zener Diode
3. Characteristics of Transistor under Common Emitter configuration
4. Characteristics of Transistor under Common Base Configuration

5. Characteristics of Transistor under Common Base Configuration
6. Characteristics of UJT
7. Characteristics of FET
8. Characteristics of SCR
9. Characteristics of DIAC
10. Characteristics of TRIAC
11. Characteristics of LDR
12. Characteristics of PHOTO DIODE
13. Case study: Biomedical application in electron device.

The following National Instruments (NI) products will be used:

1. NI ELVIS Circuit Prototyping Hardware
2. NI LabVIEW System Design Software
3. NI Multisim Circuit Simulation Software
4. NI Ultiboard PCB Design Software

REFERENCES

1. Devices Laboratory manual

<table>
<tr><td colspan="14">BM1002 MEDICAL ELECTRONIC DEVICES LAB</td></tr>
<tr><td colspan="2">Course designed by</td><td colspan="12">Department of Biomedical Engineering</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Student outcome</td><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td>g</td><td>h</td><td>i</td><td>j</td><td>k</td></tr>
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<tr><td>2</td><td>Mapping of instructional objectives with student outcome</td><td>1</td><td>2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td rowspan="2">4</td><td rowspan="2">Broad area (for ‘P’category)</td><td colspan="3">Biomedical Electronics Engg</td><td colspan="3">Basics of Biomedical Engg</td><td colspan="3">Biomedical Instrumentation Engg</td><td colspan="2">Biomedical Imaging Engg</td><td>Health care Engg</td></tr>
<tr><td colspan="3">X</td><td colspan="3"></td><td colspan="3"></td><td colspan="2"></td><td></td></tr>
<tr><td>5</td><td>Approval</td><td colspan="12">23rd meeting of Academic Council, May 2013</td></tr>
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SEMESTER I/II

CS1001	**PROGRAMMING USING MATLAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**0**	**1**	**2**	**2**
	Prerequisite				
	Nil				

PURPOSE

This Lab Course will enable the students to understand the fundamentals and programming knowledge in MATLAB.

INSTRUCTIONAL OBJECTIVES

1.	To learn the MATLAB environment and its programming fundamentals
2.	Ability to write Programs using commands and functions
3.	Able to handle polynomials, and use 2D Graphic commands

LIST OF EXPERIMENTS

1. Practicing MATLAB environment with simple exercises to familiarize Command Window, History, Workspace, Current Directory, Figure window, Edit window, Shortcuts, Help files.
2. Data types, Constants and Variables, Character constants, operators, Assignment statements.
3. Control Structures: For loops, While, If control structures, Switch, Break, Continue statements.
4. Input-Output functions, Reading and Storing Data.
5. Vectors and Matrices, commands to operate on vectors and matrices, matrix Manipulations.
6. Arithmetic operations on Matrices, Relational operations on Matrices, Logical operations on Matrices.
7. Polynomial Evaluation, Roots of Polynomial, Arithmetic operations on Polynomials.
8. Graphics: 2D plots, Printing labels, Grid & Axes box, Text in plot, Bar and Pie chart.

TEXT BOOK

1. R.K.Bansal, A.K.Goel, M.K.Sharma, "*MATLAB and its Applications in Engineering*", Pearson Education, 2012.

REFERENCES

1. Amos Gilat, *"MATLAB-An Introduction with Applications*", Wiley India, 2009.
2. Stephen.J.Chapman, *"Programming in MATLAB for Engineers*", Cengage Learning, 2011.

CS1001 PROGRAMMING USING MATLAB												
Course designed by		**Department of Computer Science and Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x	**x**									**x**
2	Mapping of instructional objective with student outcome	**2,3**	**1,2,3**									**1**
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)			
		X										
4	Approval	23rd meeting of Academic Council, May 2013										

BT1001	**BIOLOGY FOR ENGINEERS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	**2**	**0**	**0**	**2**
	Prerequisite				
	Nil				

PURPOSE

The purpose of this course is to provide a basic understanding of biological mechanisms of living organisms from the perspective of engineers. In addition, the course is expected to encourage engineering students to think about solving biological problems with engineering tools.

INSTRUCTIONAL OBJECTIVES

1.	To familiarize the students with the basic organization of organisms subsequent building to a living being
2.	To impart an understanding about the machinery of the cell functions that is ultimately responsible for various daily activities.
3.	To Provide knowledge about biological problems that require engineering expertise to solve them

UNIT I – BASIC CELL BIOLOGY **(6 Hours)**

Introduction: Methods of Science-Living Organism: Cells and cell theory cell structure and Function, Genetic information, protein synthesis, and protein structure, cell metabolism-Homoeostasis-Cell growth, reproduction, and differentiation

UNIT II – BIOCHEMISTRY AND MOLECULAR ASPECTS OF LIFE (5 Hours)

Biological Diversity—Chemistry of life: chemical bonds—Biochemistry and Human biology—Protein synthesis—Stem cells and Tissue engineering

UNIT III – ENZYMES AND INDUSTRIAL APPLICATIONS (5 Hours)

Enzymes: Biological catalysts, Proteases, Carbonic anhydrase, Restriction enzymes, and Nucleoside monophosphate kinases---**Photosynthesis.**

UNIT IV - MECHANOCHEMISTRY (7 Hours)

Molecular Machines/Motors—Cytoskeleton—Bioremediation--Biosensors

UNIT V - NERVOUS SYSTEM, IMMUNE SYSTEM, AND CELL SIGNALING (5 Hours)

Nervous system—immune system-General principles of cell signaling

REFERENCES

1. ThyagaRajan S, Selvamurugan N, Rajesh M.P, Nazeer, Richard Thilagaraj R.A. Barathi. W.S and. Jaganathan, M.K "*Biology for Engineers*", W.H. Hill, New Delhi, 2012.
2. Jeremy M, Berg John.L, Tymoczko and Lubert Stryer, "*Biochemistry*", W.H. Freeman and Co.Ltd., 6th Ed., 2006.
3. Robert Weaver, "*Molecular Biology*", MCGraw-Hill, 5th edition, 2012.
4. Jon Cooper, "*Biosensors A Practical Approach*" Bellwether Books, 2004.
5. Martin Alexander, "*Biodegradation and Bioremediation*", Academic Press, 1994.
6. Kenneth Murphy, "*Jeneway's Immunobiology*",Garland Science; 8th edition, 2011.
7. Eric.R, Kandel, James.H, Schwartz, Thomas,M, Jessell, "Principles of Neural Science", McGrew-Hill, 5th Edition, 2012.

BT1001 BIOLOGY FOR ENGINEERS												
Course designed by		**Department of Mechanical Engineering**										
1	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		X			**X**							
2	Mapping of instructional objectives with student outcome	1			2							
3	Category	General (G)	Basic Sciences (B)			Engineering Sciences and Technical Art (E)				Professional Subjects (P)		
			X									
4	Approval	23rd meeting of the Academic Council , May 2013										

ME1001	BASIC MECHANICAL ENGINEERING	L	T	P	C
	Total contact Hours - 30	2	0	0	2
	Prerequisite				
	Nil				

PURPOSE

To familiarize the students with the basics of Mechanical Engineering.

INSTRUCTIONAL OBJECTIVES

1.	To familiarize with the basic machine elements
2.	To familiarize with the Sources of Energy and Power Generation
3.	To familiarize with the various manufacturing processes

UNIT I - MACHINE ELEMENTS-I (5 Hours)

Springs: Helical and leaf springs – Springs in series and parallel. **Cams:** Types of cams and followers – Cam profile.

UNIT II - MACHINE ELEMENTS-II (5 Hours)

Power Transmission: Gears (terminology, spur, helical and bevel gears, gear trains). Belt drives (types). Chain drives. **Simple Problems.**

UNIT III - ENERGY (10 Hours)

Sources: Renewable and non-renewable (various types, characteristics, advantages/disadvantages). **Power Generation:** External and internal combustion engines – Hydro, thermal and nuclear power plants (layouts, element/component description, advantages, disadvantages, applications). **Simple Problems.**

UNIT IV - MANUFACTURING PROCESSES-I (5 Hours)

Sheet Metal Work: Introduction – Equipments – Tools and accessories – Various processes (applications, advantages / disadvantages). **Welding:** Types – Equipments – Tools and accessories – Techniques employed -applications, advantages / disadvantages – Gas cutting – Brazing and soldering.

UNIT V - MANUFACTURING PROCESSES-II (5 Hours)

Lathe Practice: Types - Description of main components – Cutting tools – Work holding devices – Basic operations. **Simple Problems**. **Drilling Practice:** Introduction – Types – Description – Tools. S**imple Problems**.

TEXT BOOKS

1. Kumar, T., Leenus Jesu Martin and Murali, G., "*Basic Mechanical Engineering"*, Suma Publications, Chennai,2007.

2. Prabhu, T. J., Jai Ganesh, V. and Jebaraj, S., "*Basic Mechanical Engineering*", Scitech Publications, Chennai, 2000.

REFERENCES

1. Hajra Choudhary, S.K. and HajraChoudhary, A. K., "*Elements of Workshop TechnologyVols". I & II*, Indian Book Distributing Company Calcutta, 2007.
2. Nag, P.K., "*Power Plant Engineering*", Tata McGraw-Hill, New Delhi, 2008.
3. Rattan, S.S., "*Theory of Machines*", Tata McGraw-Hill, New Delhi, 2010.

ME1001 BASIC MECHANICAL ENGINEERING												
Course designed by		Department of Mechanical Engineering										
1	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		X				X						
2	Mapping of instructional objectives with student outcome	1, 2, 3				1, 2, 3						
3	Category	General (G)	Basic Sciences (B)			Engineering Sciences and Technical Art (E)			Professional Subjects (P)			
						X						
4	Approval	23rd meeting of the Academic Council , May 2013										

EE1001	BASIC ELECTRICAL ENGINEERING	L	T	P	C
	Total Contact Hours - 30	2	0	0	2
	Prerequisite				
	Nil				

PURPOSE

This course provides comprehensive idea about circuit analysis, working principles of machines and common measuring instruments.

INSTRUCTIONAL OBJECTIVES

1.	Understand the basic concepts of magnetic circuits, AC & DC circuits.
2.	Explain the working principle, construction, applications of DC & AC machines and measuring instruments.
3.	Gain knowledge about the fundamentals of wiring and earthing

UNIT I – FUNDAMENTALS OF DC CIRCUITS (6 Hours)

Introduction to DC and AC circuits, Active and passive two terminal elements, Ohms law, Voltage-Current relations for resistor, inductor, capacitor , Kirchhoff's laws, Mesh

analysis, Nodal analysis, Ideal sources –equivalent resistor, current division, voltage division

UNIT II – MAGNETIC CIRCUITS (6 Hours)

Introduction to magnetic circuits-Simple magnetic circuits-Faraday's laws, induced emfs and inductances

UNIT III – AC CIRCUITS (6Hours)

Sinusoids, Generation of AC, Average and RMS values, Form and peak factors, concept of phasor representation, J operator. Analysis of R-L, R-C, R-L-C circuits. Introduction to three phase systems - types of connections, relationship between line and phase values.

UNIT IV– ELECTRICAL MACHINES & MEASURING INSTRUMENTS (6 Hours)

Working principle, construction and applications of DC machines and AC machines (1 - phase transformers, single phase induction motors: split phase, capacitor start and capacitor start & run motors).

Basic principles and classification of instruments -Moving coil and moving iron instruments .

UNIT V– ELECTRICAL SAFETY, WIRING &INTRODUCTION TO POWER SYSTEM (6 Hours)

Safety measures in electrical system- types of wiring- wiring accessories- staircase, fluorescent lamps & corridor wiring- Basic principles of earthing-Types of earthing-Simple layout of generation, transmission & distribution of power.

TEXT BOOK

1. Dash S.S, SubramaniC, VijayakumarK,*"BasicElectrical Engineering"*, First edition,Vijay Nicole Imprints Pvt.Ltd,2013.

REFERENCES:

1. Smarajt Ghosh, "*Fundamentals of Electrical & Electronics Engineering*", Second edition, PHI Learning, 2007
2. V.K.Metha, Rohit Metha, "*Basic Electrical Engineering*" Fifth edition, S.Chand & Co, 2012
3. Kothari D. P and Nagrath IJ, "*Basic Electrical Engineering*", Second edition, Tata McGraw Hill, 2009
4. S. K. Bhattacharya, "*Basic Electrical and Electronics Engineering"*, First edition, Pearson Education,2011

EE1001 - BASIC ELECTRICAL ENGINEERING												
Course designed by		**Department of Electrical and Electronics Engineering**										
1	Student outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
		X				**X**						
2	Mapping of instructional objectives with student outcome	1,2,3				1						
3	Category	General (G)			Basic Sciences (B)			Engineering Sciences and Technical Arts(E)		Professional Subjects(P)		
								x				
4	Broad area (for 'P'category)	Electrical Machines		Circuits and Systems		Electronics			Power System		Intelligent Systems	
5	Approval	23rd meeting of Academic Council, May 2013										

EC1001	**BASIC ELECTRONICS ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	**2**	**0**	**0**	**2**
	Prerequisite				
	Nil				

PURPOSE

This course provides comprehensive idea about working principle, operation and characteristics of electronic devices, transducers, Digital Electronics and Communication Systems.

INSTRUCTIONAL OBJECTIVES

At the end of the course students will be able to gain knowledge about the

1.	Fundamentals of electronic components, devices, transducers,
2.	Principles of digital electronics, and
3.	Principles of various communication systems

UNIT I - ELECTRONIC COMPONENTS (4 Hours)

Passive components – resistors, capacitors & inductors (properties, common types, I-V relationship and uses).

UNIT II - SEMICONDUCTOR DEVICE (7 Hours)

Semiconductor Devices - Overview of Semiconductors - basic principle, operation and characteristics of PN diode, zener diode, BJT, JFET, optoelectronic devices (LDR, photodiode, phototransistor, solar cell, optocouplers)

UNIT III - TRANSDUCERS **(5 Hours)**

Transducers - Instrumentation – general aspects, classification of transducers, basic requirements of transducers, passive transducers - strain gauge, thermistor, Hall-Effect transducer, LVDT, and active transducers – piezoelectric and thermocouple.

UNIT IV - DIGITAL ELECTRONICS **(7 Hours)**

Number systems – binary codes - logic gates - Boolean algebra, laws & theorems - simplification of Boolean expression - implementation of Boolean expressions using logic gates - standard forms of Boolean expression.

UNIT V - COMMUNICATION SYSTEMS **(7 Hours)**

Block diagram of a basic communication system – frequency spectrum - need for modulation - methods of modulation - principles of AM, FM, pulse analog and pulse digital modulation – AM / FM transmitters & receivers (block diagram description only)

TEXT BOOKS

1. Thyagarajan T, SendurChelvi K.P, Rangaswamy T.R, *"Engineering Basics: Electrical, Electronics and Computer Engineering"*, New Age International, Third Edition, 2007.
2. Somanathan Nair B, Deepa S.R, "*Basic Electronics",* I.K. International Pvt. Ltd., 2009.

REFERENCES

1. Thomas L. Floyd, *"Electronic Devices",* Pearson Education, 9th Edition, 2011.
2. R.K. Rajput, *"Basic Electrical and Electronics Engineering"*, Laxmi Publications, First Edition, 2007.

EC1001 BASIC ELECTRONICS ENGINEERING												
Course designed by		**Department of Electronics and Communication Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		X										
2	Mapping of instructional objectives with student outcome	1,2,3										
3	Category	General (G)		Basic Sciences (B)			Engineering Sciences & Technical Arts (E)			Professional Subjects (P)		
							X					
4	Broad area	Communication			Signal Processing		Electronics		VLSI	Embedded		
		--			--		--		--	--		
5	Approval	23rd meeting of Academic Council, May 2013										

	WORKSHOP PRACTICE	L	T	P	C
ME1004	Total contact Hours - 75	0	0	3	2
	Prerequisite				
	Nil				

PURPOSE

To provide the students with hands on experience on differedt trades of engineering like fitting, carpentry, smithy, welding and sheet metal.

INSTRUCTIONAL OBJECTIVES

1.	To familiarize with the basics of tools and equipments used in fitting, carpentry, sheet metal, welding and smithy
2.	To familiarize with the production of simple models in the above trades.

UNIT I - FITTING **(9 Hours)**

Tools & Equipments – Practice in filling.
Making Vee Joints, Square, Dovetail joints are key making – plumbing.
Mini project Assembly of simple I.C. engines

UNIT II - CARPENTRY **(9 Hours)**

Tools and Equipments – Planning practice
Making Half Lap, Dovetail, Mortise & Tenon joints.
Mini project – model of a single door window frame.

UNIT III – STEEL METAL **(9Hours)**

Tools and Equipments – practice
Making rectangular tray, hopper, scoop, etc
Mini project – Fabrication of a small cabinet, dust bin, etc

UNIT IV - WELDING **(9 Hours)**

Tools and equipments –
Arc welding of butt joint, Lap joint, Tee fillet.
Demonstration of gas welding, TIG & MIG welding.

UNIT V - SMITHY **(9 Hours)**

Tools and Equipments –
Making simple parts like hexagonal headed bolt, chisel.

TEXT BOOKS

1. Gopal T.V. Kumar T, and Murali G, "A first course on workshop practice Theory, Practice and work Book", Suma Publications, Chennai, 2005.

REFERENCES

1. Kannaiah P, and Narayanan K.C, "Manual on Workshop Practice", Scitech Publications, Chennai, 1999.
2. Venkatachalapathy V.S, "First year Engineering Workshop Practice", Ramalinga Publications, Madurai 1999.
3. Laboratory Manual.

ME1004 WORKSHOP PRACTICE												
Course designed by		**Department of Mechanical Engineering**										
1	Student Outcome	a	b	c	d	e	f	g	h	i	j	K
			X	**X**				**X**				
2	Mapping of instructional objectives with student outcome		**1, 2**	**1, 2**				**1, 2**				
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences And Technical Art (E)		Professional Subjects (P)				
						X						
5	Approval	23rd meeting of the Academic Council , May 2013										

ME1005	**ENGINEERING GRAPHICS**	**L**	**T**	**P**	**C**
	Total contact Hours - 75	**0**	**1**	**4**	**3**
	Prerequisite				
	Nil				

First Angle Projection is to be followed - Practice with Computer Aided Drafting tools

PURPOSE

1. To draw and interpret various projections of 1D, 2D and 3D objects.
2. To prepare and interpret the drawings of buildings.

INSTRUCTIONAL OBJECTIVES

1.	To familiarize with the construction of geometrical figures
2.	To familiarize with the projection of 1D, 2D and 3D elements
3.	To familiarize with the sectioning of solids and development of surfaces
4.	To familiarize with the Preparation and interpretation of building drawing

UNIT I - FUNDAMENTALS OF ENGINEERING GRAPHICS (2 Hours)

Lettering – Two dimensional geometrical constructions – Conics – Representation of three-dimensional objects – Principles of projections – Standard codes – Projection of points.

UNIT II - PROJECTION OF LINES AND SOLIDS (4 Hours)

Projection of straight lines – Projection of planes - Projection of solids – Auxiliary projections.

UNIT III - SECTIONS AND DEVELOPMENTS (3 Hours)

Sections of solids and development of surfaces.

UNIT IV - PICTORIAL PROJECTIONS (4 Hours)

Conversion of Projections: Orthographic projection – Isometric projection of regular solids and combination of solids.

UNIT V - BUILDING DRAWING (2 Hours)

Plan, Elevation and section of single storied residential (or) office building with flat RCC roof and brick masonry walls having not more than 3 rooms (planning / designing is not expected in this course) with electrical wiring diagram.

PRACTICAL (60 Hours)

TEXT BOOKS

2. Venugopal, K. and Prabhu Raja, V., "*Engineering Graphics"*, Eighth Edition (Revised), New Age International Publishers, Chennai, 2007.
3. Natarajan, K.V., *A Text Book of "Engineering Graphics"*, 21st Edition, Dhanalakshmi Publishers, Chennai, 2012.
4. Jeyapoovan, T., "*Engineering Drawing and Graphics using AutoCAD"*, Vikas Publishing House Pvt. Ltd., New Delhi, 2010.

REFERENCES

4. Bethune, J.D., "*Engineering Graphics with AutoCAD"* 2013, PHI Learning Private Limited, Delhi, 2013.
5. Bhatt, N.D., "*Elementary Engineering Drawing (First Angle Projection)"*, Charota Publishing Co., Anand, 1999.
6. Narayanan, K. L. and Kannaiah, P., "*Engineering Graphics*," Scitech Publications, Chennai, 1999.
7. Shah, M. B. and Rana, B. C., "*Engineering Drawing"*, Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2005.

ME1005 ENGINEERING GRAPHICS												
Course designed by		Department of Mechanical Engineering										
1	Student Outcome	a	b	c	d	e	f	g	h	i	j	K
			X	X				X				
2	Mapping of instructional objectives with student outcome		1, 2, 3, 4	1, 2, 3, 4				1, 2, 3, 4				
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences And Technical Art (E)		Professional Subjects (P)				
						X						
5	Approval	23rd meeting of the Academic Council , May 2013										

EC1002	ELECTRONICS ENGINEERING PRACTICES	L	T	P	C
	Total Contact Hours - 30	0	0	2	1
	Prerequisite				
	Nil				

PURPOSE

To equip the students with the knowledge of PCB design and fabrication processes.

INSTRUCTIONAL OBJECTIVES

1.	To familiarize the electronic components and basic electronic instruments.
2.	To make familiar with PCB design and various processes involved.
3.	To provide in-depth core knowledge in the and fabrication of Printed Circuit Boards.
4.	To provide the knowledge in assembling and testing of the PCB based electronic circuits.

UNIT I - INTRODUCTION TO BASICS OF ELECTRONIC COMPONENTS AND INSTRUMENTS (4 Hours)

Study of electronic components- active & passive, Electronic Instruments: CRO, Function generator, Power Supply, Multi-meter, IC tester. Solder practice.

UNIT II - SCHEMATIC CAPTURE (6 Hours)

Introduction to OrCAD schematic capture tool, Simulation of simple electronic circuit, Schematic to layout transfer, Layout Printing

UNIT III - PCB DESIGN PROCESS **(6 Hours)**

Conception Level Introduction: Specifying Parts, Packages and Pin Names, Libraries and Checking foot prints of the components, Partlist, Netlist, Making Netlist Files, Placing Parts, Routing Traces, Modifying Traces, Mounting Holes, Adding Text, PCB Layout, DRC, Pattern Transfer

UNIT IV - PCB FABRICATION PROCESS **(6 Hours)**

Etching, cleaning, drying and drilling

UNIT -V - ASSEMBLING AND TESTING **(8 Hours)**

Identifying the components and its location on the PCB, soldering of active and passive components, Testing the assembled circuit for correct functionality

TEXT BOOKS

1. Orcad User manual
2. Printed Circuit Boards: "*Design, Fabrication, and Assembly*" (McGraw-Hill Electronic Engineering-2006) by Raghbir Singh Khandpur.

REFERENCE

1. Department Laboratory Manual

<table>
<tr><th colspan="13">EC1002 ELECTRONICS ENGINEERING PRACTICES</th></tr>
<tr><td colspan="2">Course designed by</td><td colspan="11">Department of Electronics and Communication Engineering</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Student outcome</td><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td>g</td><td>h</td><td>i</td><td>j</td><td>k</td></tr>
<tr><td>X</td><td>X</td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2</td><td>Mapping of instructional objectives with student outcome</td><td>1</td><td>2-3</td><td>2 - 3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td rowspan="2">4</td><td rowspan="2">Broad area (for 'P'category)</td><td colspan="3">Communication</td><td colspan="3">Signal Processing</td><td>Electronics</td><td>VLSI</td><td colspan="3">Embedded</td></tr>
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<tr><td>5</td><td>Approval</td><td colspan="11">23rd meeting of Academic Council, May 2013</td></tr>
</table>

EE1002	ELECTRICAL ENGINEERING PRACTICES	L	T	P	C
	Total Contact Hours - 30	0	0	2	1
	Prerequisite				
	Nil				

PURPOSE

To provide exposure to the students with hands on experience on various Electrical Engineering practices.

INSTRUCTIONAL OBJECTIVES

At the end of the course students will be able

1.	To learn the residential wiring and various types of wiring.
2.	To measure the various electrical quantities.
3.	To gain knowledge about the fundamentals of various electrical gadgets and their working and trouble shooting of them.
4.	To design a prototype of a transformer.
5.	To know the necessity and types of earthing and measurement of earth resistance.

LIST OF EXPERIMENTS

1. Residential wiring (using Energy meter, fuses, switches, indicator, lamps, etc)
2. Types of wiring (fluorescent lamp wiring, staircase wiring, godown wiring, etc)
3. Measurement of electrical quantities (like voltage, current, power, power factor in RLC circuits)
4. Measurement of energy (using single phase and three phase energy meter)
5. Study of Earthing and Measurement of Earth resistance.
6. Study of trouble shooting of electrical equipments (fan, iron box, mixer-grinder, etc)
7. Study of various electrical gadgets (Induction motor, transformer, CFL, LED, PV cell, etc)
8. Assembly of choke or small transformer.

REFERENCES

1. Subhransu Sekhar Dash & K.Vijayakumar, “Reference Electrical Engineering Practice Lab Manual”. Vijay Nocole imprints private Ltd., First Edition, (2013)
2. Jeyachandran K, Natarajan S& Balasubramanian S, “ A Primer on engineering practices laboratory”, Anuradha Publications (2007)
3. Jeyapoovan T, Saravanapandian M & Pranitha S, “Engineering practices lab manual”,Vikas Publishing House Pvt., Ltd., (2006)

EE1002 ELECTICAL ENGINEERING PRACTICES												
Course designed by		**Department of Electrical and Electronics Engineering**										
1	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
		X	**X**	**X**								
2	Mapping of instructional objectives with student outcome	1-5	2,5	4								
3	Category	General (G)	Basic Sciences (B)	Engineering Sciences and Technical Arts(E)	Professional Subjects(P)							
				x								
4	Broad area (for 'P'category)	Electrical Machines	Circuits and Systems	Electronics	Power System	Intelligent Systems						
			X									
5	Approval	23rd meeting of Academic Council, May 2013										

NC1001/ NS1001/ SP1001/ YG1001	**NATIONAL CADET CORPS (NCC)/ NATIONAL SERVICE SCHEME (NSS)/ NATIONAL SPORTS ORGANIZATION (NSO) / YOGA**	**L**	**T**	**P**	**C**
	Total Contact Hours – 15 (minimum, but may vary depending on the course)	**0**	**0**	**1**	**1**
	Prerequisite				
	Nil				
PURPOSE					
To imbibe in the minds of students the concepts and benefits of NCC/NSS/NSO/YOGA and make them practice the same					
INSTRUCTIONAL OBJECTIVES					
1.	To enable the students to gain knowledge about NCC/NSS/NSO/YOGA and put the same into practice				

NATIONAL CADET CORPS (NCC)

Any student enrolling as a member of National Cadet Core (NCC) will have to attend sixteen parades out of twenty parades each of four periods over a span of academic year. Attending eight parades in first semester will qualify a student to earn the credits specified in the curriculum. Grading shall be done based on punctuality, regularity in attending the parades and the extent of active involvement.

NATIONAL SERVICE SCHEME (NSS)

A student enrolling as member of NSS will have to complete 60 Hours of training / social service to be eligible to earn the credits specified in the curriculum. Grading shall be done by the faculty member handling the course based on punctuality, regularity in attending the classes and the extent of active involvement.

NATIONAL SPORTS ORGANIZATION (NSO)

Each student must select one of the following games/sports events and practice for one hour per week. An attendance of 75% is compulsory to earn the credits specified in the curriculum. Grading shall be done by the faculty member handling the course based on punctuality, regularity in attending the classes and the extent of active involvement. List of games/sports:

Basket Ball, Football, Volley Ball, Ball Badminton, Cricket, Throw-ball, Track events Field events or any other game with the approval of faculty member.

YOGA

Benefits of Agnai Meditation -Meditation - Agnai, Asanas, Kiriyas, Bandas, Muthras Benefits of santhi Meditation - Meditation Santhi Physical Exercises (I & II) Lecture & Practice - Kayakalpa Yoga Asanas, Kiriyas, Bandas, Muthras Analysis of Thought - Meditation Santhi Physical Exercises III & IV Benefits of Thuriyam - Meditation Thuriyam Kayakalpa Asanas, Kiriyas, Bandas, Muthras Attitude - Meditation Thuriyam Kayakalpa Asanas, Kiriyas, Bandas, Muthras Importance of Arutkappy & Blessings - Meditation Thuriyam Kayakalpa Asanas, Kiriyas, Bandas, Muthras Benefits of Blessings - Meditation Santhi Kayakalpa Asanas, Kiriyas, Bandas, Muthras

ASSESSMENT

An attendance of 75% is compulsory to earn the credits specified in the curriculum. Grading shall be done by the faculty member handling the course based on punctuality, regularity in attending the classes and the extent of active involvement.

TEXT BOOKS

1. Yogiraj Vethathiri Maharishi, "Yoga for Modern Age", Vethathiri Publishers, 1989.
2. Vethathiri Maharishi T, "Simplified Physical Exercises", Vethathiri Publishers, 1987.

NC1001/ NS1001/ SP1001/ YG1001		NATIONAL CADET CORPS (NCC)/ NATIONAL SERVICE SCHEME (NSS)/ NATIONAL SPORTS ORGANIZATION (NSO)/YOGA										
Course designed by		NCC/ NSS/NSO/YOGA UNITS										
1	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
2	Mapping of instructional objectives with student outcome				x					x		
3	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts(E)			Professional Subjects(P)		
		X										
4	Approval	23rd meeting of Academic Council, May 2013										

SEMESTER III

LE1003	**GERMAN LANGUAGE PHASE I**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	**2**	**0**	**0**	**2**
	Prerequisite				
	Nil				

PURPOSE

Germany offers infinite opportunities for students of engineering for higher studies, research and employment in Germany. B.Tech Students are offered German Language during their second year. Knowledge of the language will be helpful for the students to adjust themselves when they go for higher studies.

INSTRUCTIONAL OBJECTIVES

1.	To introduce the language, phonetics and the special characters in German language
2.	To introduce German culture & traditions to the students.
3.	By the end of Phase – I, the students will be able to introduce themselves and initiate a conversation..
4.	We endeavor to develop the ability among the students to read and understand small texts written in German
5.	To enable the students to elementary conversational skills.

UNIT I (**6 Hours)**

Wichtige Sprachhandlungen: Phonetics – Sich begrüßen - Sich und andere vorstellen formell / informell - Zahlen von 1 bis 1 Milliarde - verstehen & sprechen
Grammatik: regelmäßige Verben im Präsens - "sein" und haben im Präsens - Personalpronomen im Nominativ

UNIT II **(6 Hours)**

Wichtige Sprachhandlungen Telefon Nummern verstehen und sprechen
Uhrzeiten verstehen und sagen Verneinung "nicht und kein" (formell und informell)
Grammatik : Wortstellung – Aussagesatz – W-Frage und Satzfrage (Ja/Nein Frage) Nomen buchstabieren und notieren bestimmter und unbestimmter Artikel und Negativartikel im Nom. & Akkusativ

UNIT III **(6 Hours)**

Wichtige Sprachhandlungen Tageszeiten verstehen und über Termine sprechen - Verabredungen verstehen - Aufgaben im Haushalt verstehen

Grammatik Personalpronomen im Akkusativ und Dativ - W-Fragen “wie, wer, wohin,wo, was usw.- Genitiv bei Personennamen - Modalverben im Präsens “können, müssen, möchten”

UNIT IV **(6 Hours)**

Wichtige Sprachhandlungen Sich austauschen, was man kann, muss – Bezeichnungen Lebensmittel – Mengenangaben verstehen – Preise verstehen und Einkaufzettel schreiben

Grammatik Wortstellung in Sätzen mit Modalverben – Konnektor ”und” – “noch”-kein-------mehr – “wie viel, wie viele, wie alt, wie lange” –Possessivartikel im Nominativ.

UNIT V **(6 Hours)**

Wichtige Sprachhandlungen Freizeitanzeigen verstehen – Hobbys und Sportarten Anzeigen für Freizeitpartner schreiben bzw. darauf antworten – Vorlieben und Abneigungen ausdrucken

Grammatik Verben mit Vokalwechsel im Präsens – Modalverben im Präsens “ dürfen, wollen und mögen - “haben und sein” im Präteritum – regelmäßige Verben im Perfekt – Konnektoren “denn, oder, aber

TEXT BOOK

1. Studio d A1. Deutsch als Fremdsprache with CD.(Kursbuch und Sprachtraining).

REFERENCES

1. German for Dummies
2. Schulz Griesbach

<table>
<tr><th colspan="12">LE1003 GERMAN LANGUAGE PHASE I</th></tr>
<tr><td colspan="2">Course designed by</td><td colspan="10">Department of English and Foreign Languages</td></tr>
<tr><td colspan="12"></td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Student outcome</td><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td>g</td><td>H</td><td>i</td><td>j</td><td>k</td></tr>
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<tr><td>4</td><td>Approval</td><td colspan="10">23rd meeting of Academic Council, May 2013</td></tr>
</table>

LE1004	FRENCH LANGUAGE PHASE I	L	T	P	C
	Total contact Hours - 30	2	0	0	2
	Prerequisite				
	Nil				

PURPOSE

To enable the student learners acquire a basic knowledge of the French language and concepts of general French for everyday interactions and technical French at the beginner's level and also to get to know the culture of France .

INSTRUCTIONAL OBJECTIVES

1.	To enable students improve their grammatical competence.
2.	To enhance their listening skills.
3	To assist students in reading and speaking the language.
4.	To enhance their lexical and technical competence.
5.	To help the students introduce themselves and focus on their communication skills.

UNIT I **(6 Hours)**

1. Grammar and Vocabulary: Usage of the French verb "se presenter", a verb of self- introduction and how to greet a person- "saluer"
2. Listening and Speaking – The authentic sounds of the letters of the French alphabet and the accents that play a vital role in the pronunciation of the words.
3. Writing – correct spellings of French scientific and technical vocabulary.
4. Reading -- Reading of the text and comprehension – answering questions.

UNIT II **(6 Hours)**

1. rammar and Vocabulary – Definite articles , "prepositions de lieu" subject pron ouns
2. Listening and Speaking – pronunciation of words like Isabelle, presentez and la liaison – vous etes, vous appelez and role play of introducing each other – group activity
3. Writing – particulars in filling an enrollment / registration form
4. Reading Comprehension – reading a text of a famous scientist and answering questions.

UNIT III **(6 Hours)**

1. Grammar and Vocabulary – verb of possession "avoir' and 1st group verbs "er", possessive adjectives and pronouns of insistence- moi, lui..and numbers from 0 to 20

2. Listening and Speaking –nasal sounds of the words like feminine, ceinture , parfum and how to ask simple questions on one's name, age, nationality, address mail id and telephone number.
3. Writing –conjugations of first group verbs and paragraph writing on self – introduction and introducing a third person.
4. Reading Comprehension – reading a text that speaks of one's profile and answering questions

UNIT IV **(6 Hours)**

1. Grammar and Vocabulary –negative sentences, numbers from 20 to 69, verb "aimer"and seasons of the year and leisure activities.
2. Listening and Speaking – To express one's likes and dislikes and to talk of one's pastime activities (sports activities), je fais du ping-pong and nasal sounds of words – janvier, champagne
3. Writing- conjugations of the irregular verbs – faire and savoir and their usage. Paragraph writing on one's leisure activity- (passé temps favori).Conj
4. Reading- a text on seasons and leisure activities – answering questions.

UNIT V **(6 Hours)**

1. Grammar and Vocabulary – les verbes de direction- to ask one's way and to give directions, verbes- pouvoir and vouloir and 2nd group verbs , a droite, la premiere a gauche and vocabulary relating to accommodation.
2. Listening and Speaking – to read and understand the metro map and hence to give one directions – dialogue between two people.
3. Writing –paragraph writing describing the accommodation using the different prepositions like en face de, derriere- to locate .
4. Reading Comprehension -- a text / a dialogue between two on location and directions- ou est la poste/ la pharmacie, la bibliotheque?.....

TEXT BOOKS

1. Tech French

REFERENCES

1. French for Dummies.
2. French made easy-goyal publishers
3. Panorama

LE1004 FRENCH LANGUAGE PHASE I												
Course designed by		**Department of English and Foreign Languages**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
								X				
2	Mapping of instructional objectives with student outcome							1 - 5				
3	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
		X										
4	Approval	23rd meeting of Academic Council, May 2013										

	JAPANESE LANGUAGE PHASE I	L	T	P	C
LE1005	Total contact Hours- 30	**2**	**0**	**0**	**2**
	Prerequisite				
	Nil				

PURPOSE

To enable students achieve a basic exposure on Japan, Japanese language and culture.
To acquire basic conversational skill in the language.

INSTRUCTIONAL OBJECTIVES

1.	To help students learn the Japanese scripts viz. hiragana and a few basic kanji.
2.	To make the students acquire basic conversational skill.
3	To enable students to know about Japan and Japanese culture.
4.	To create an advantageous situation for the students to have better opportunity for employability by companies who have association with Japan.

UNIT I **(8 Hours)**

Introduction to Japanese language. Hiragana Chart 1 - vowels and consonants and related vocabulary. Self introduction Grammar – usage of particles wa, no, mo and ka and exercises Numbers (1-100) Kanji – introduction and basic kanjis – naka, ue, shita, kawa and yama Greetings, seasons, days of the week and months of the year Conversation – audio Japan – Land and culture

UNIT II **(8 Hours)**

Hiragana Chart 1 (contd.) and related vocabulary

Grammar – usage of kore, sore, are, kono, sono, ano, arimasu and imasu. Particles – ni (location) and ga. Donata and dare.
Numbers (up to 99,999)
Kanji – numbers (1-10, 100, 1000, 10,000 and yen)
Family relationships and colours.
Conversation – audio
Festivals of Japan

UNIT III **(5 Hours)**

Hiragana Charts 2&3, double consonants, vowel elongation and related vocabulary Lesson 3
Grammar - particles ni (time), kara, made and ne. Koko, soko, asoko and doko.
Time expressions (today, tomorrow, yesterday, day before, day after)
Kanji – person, man, woman, child, tree and book
Directions – north, south, east and west

UNIT IV **(5 Hours)**

Grammar - directions,-kochira, sochira, achira and dochira. Associated vocabulary (mae, ushiro, ue, shita, tonari, soba, etc.)
Conversation – audio
Japanese art and culture like ikebana, origami, etc.

UNIT V **(4 Hours)**

Kanji – hidari, migi, kuchi
Japanese sports and martial arts

TEXT BOOKS

First lessons in "*Japanese*," ALC Japan

REFERENCES

1. *"Japanese for dummies"*. Wiley publishing co. Inc., USA.
2. Kana workbook, Japan foundation

LE1005 JAPANESE LANGUAGE PHASE I												
Course designed by		Department of English and Foreign Languages										
1	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
								X				
2	Mapping of instructional objectives with student outcome							**1-4**				
3	Category	General (G)			Basic Sciences (B)			Engineering Sciences and Technical Arts (E)			Professional Subjects (P)	
		x						**x**				
4	Approval	23rd meeting of Academic Council, May 2013										

LE1006	KOREAN LANGUAGE PHASE I	L	T	P	C
	Total contact Hours - 30	**2**	**0**	**0**	**2**
	Prerequisite				
	Nil				

PURPOSE

To enable students achieve a basic exposure on Korea, Korean language and culture. To acquire basic conversational skill in the language.

INSTRUCTIONAL OBJECTIVES

1.	To help students learn the scripts.
2.	To make the students acquire basic conversational skill.
3	To enable students to know about Korean culture.
4.	To create an advantageous situation for the students to have better opportunity for employability by companies who have association with Korea.

UNIT-I **(6 Hours)**

Lesson 1 < Introduction to Korean Language >, Lesson2 < Consonants and Vowels >, <Basic Conversation, Vocabularies and Listening >

UNIT - II **(10 Hours)**

Lesson 3 < Usage of "To be" >, Lesson 4 < Informal form of "to be" >, Lesson 5 <Informal interrogative form of "to be" >, Lesson 6 < To be, to have, to stay >, < Basic Conversation, Vocabularies and Listening >

UNIT - III **(10 Hours)**

Lesson 7 < Interrogative practice and Negation >, < Basic Conversation, Vocabularies and Listening >

UNIT - IV **(4 Hours)**

Lesson 8 < Korean Culture and Business Etiquette >, < Basic Conversation, Vocabularies and Listening

TEXT BOOKS

1. Korean Through English 1 (Basic Korean Grammar and Conversation)

REFERENCES

1. Bharati Korean (Intermediate Korean Grammar)
2. Hand-outs
3. Various visual mediums such Movie CD, Audio CD
4. Collection of vocabularies for engineering field.

LE1006 KOREAN LANGUAGE PHASE I												
Course designed by		Department of English and Foreign Languages										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
								X				
2	Mapping of instructional objectives with student outcome							↕ ⇅ ↓				
3	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
		X										
4	Approval	23rd meeting of Academic Council, May 2013										

LE1007	CHINESE LANGUAGE PHASE I	L	T	P	C
	Total contact Hours- 30	2	0	0	2
	Prerequisite				
	Nil				

PURPOSE

To enable students achieve a basic exposure on China, Chinese language and culture. To acquire basic conversational skill in the language.

INSTRUCTIONAL OBJECTIVES

1.	To help students learn the Chinese scripts.
2.	To make the students acquire basic conversational skill.
3	To enable students to know about China and Chinese culture.
4.	To create an advantageous situation for the students to have better opportunity for employability by companies who have association with china.

UNIT I

Introduction of Chinese Language

UNIT II

Phonetics and Notes on pronunciation

a) 21 Initials:

b p m f d t n l g k h j q x z c s zh ch sh r

b) 37 Finals:

a	o	e	i	u	ü
ai	ou	ei	ia	ua	üe
an	ong	en	ian	uai	üan
ang		eng	iang	uan	ün
ao		er	iao	uang	
			ie	uei(ui)	
			in	uen(un)	
			ing	ueng	
			iong	uo	
			iou(iu)		

c) The combination of Initials and Finals - Pinyin

UNIT III

Introduction of Syllables and tones

a) syllable=initial+final+tone

b) There are four tones in Chinese: the high-and-level tone, the rising tone , the falling-and-rising tone, and the falling tone. And the markers of the different tones.

UNIT IV

A. Tones practice

B. the Strokes of Characters

1. Introduction of Chinese Characters
2. The eight basic strokes of characters

UNIT V

1. Learn to read and write the Characters:

八(eight) 不(not) 马(horse) 米(rice) 木(wood)

2. **classes are organized according to several Mini-dialogues**

TEXT BOOKS

1. A New Chinese Course 1- "*Beijing Language and Culture University*" Press

REFERENCES

1. New Practical Chinese Reader Textbook (1) – "*Beijing Language and Culture University*" Press
2. 40 Lessons For "*Basic Chinese Course"* I – Shanghai Translation Press
3. My Chinese Classroom - East China Normal University Press

LE1007 CHINESE LANGUAGE PHASE I												
Course designed by		**Department of English and Foreign Languages**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
								X				
2	Mapping of instructional objectives with student outcome							1to4				
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)		Professional Subjects (P)				
		X										
4	Approval	23rd meeting of Academic Council, May 2013										

		L	**T**	**P**	**C**
PD1003	**APTITUDE I**	**1**	**0**	**1**	**1**
	Total Contact Hours - 30				
	Prerequisite				
	Nil				

PURPOSE

To enhance holistic development of students and improve their employability skills.

INSTRUCTIONAL OBJECTIVES

1.	To improve aptitude, problem solving skills and reasoning ability of the student.
2.	To collectively solve problems in teams & group.

UNIT I – NUMBERS **(6 Hours)**

Types and Properties of Numbers, LCM, GCD, Fractions and decimals, Surds

UNIT II - ARITHMETIC – I **(6 Hours)**

Percentages, Profit & Loss, Simple Interest & Compound Interest, , Clocks & calendars

UNIT III - ALGEBRA - I **(6 Hours)**

Logarithms, Problems on ages

UNIT IV - MODERN MATHEMATICS - **(6 Hours)**

Permutations, Combinations, Probability

UNIT V – REASONING **(6 Hours)**

Logical Reasoning, Analytical Reasoning

ASSESSMENT

1. Objective type – Paper based / Online – Time based test

REFERENCES

1. Agarwal.R.S – *"Quantitative Aptitude for Competitive Examinations",* S.Chand Limited 2011
2. Abhijit Guha*, "Quantitative Aptitude for Competitive Examinations",* Tata McGraw Hill, 3rd Edition*,* 2011
3. Edgar Thrope, *Test Of "Reasoning for Competitive Examinations",* Tata McGraw Hill, 4th Edition, 2012
4. *"Other material related to quantitative aptitude"*

PD1003 APTITUDE I												
Course designed by		**Career Development Centre**										
1	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		X			X							
2	Mapping of instructional objectives with student outcome	1			2							
3	Category	General (G)			Basic Sciences (B)			Engineering Sciences and Technical Arts (E)			Professional Subjects (P)	
		X										
4	Approval	23rd meeting of Academic Council, May 2013										

MA1033	MATHEMATICS FOR BIOMEDICAL ENGINEERING	L	T	P	C
	Total contact Hours - 60	4	0	0	4
	Prerequisite				
	Nil				

PURPOSE

To impart analytical ability in solving mathematical problems as applied to Biomedical Engineering.

INSTRUCTIONAL OBJECTIVES:

1	To know to formulate and solve partial differential equations.
2	To have thorough knowledge in Fourier series.
3	To be familiar with applications of partial differential equations.
4	To gain good knowledge in the application of Fourier transform.
5	To gain good knowledge in graph theory concepts.

UNIT I - PARTIAL DIFFERENTIAL EQUATIONS (12 Hours)

Formation – Solution of standard types of first order equations – Lagrange's equation – Linear homogeneous partial differential equations of second and higher order with constant coefficients - Classification of second order linear partial differential equations including the reduction to the above types.

UNIT II - FOURIER SERIES (12 Hours)

Dirichlet's conditions – General Fourier series – Half range Sine and Cosine series – Parseval's identity – Harmonic Analysis.

UNIT III - ONE DIMENSIONAL WAVE & HEAT EQUATION (12Hours)

Boundary and initial value problems - Transverse vibrations of elastic string with fixed ends – Fourier series solutions – One dimensional heat equation - Steady and transient states – problems – Excluding thermally insulated ends.

UNIT IV - FOURIER TRANSFORMS (12 Hours)

Statement of Fourier integral theorem(proof omitted) – Fourier transform pairs – Fourier Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity – Integral equations.

UNIT V - GRAPH THEORY (12 Hours)

Graphs; Isomorphism-Walk; Path; Circuit; Shortest Path: Dijkstra's Algorithm; Tree; Properties of Tree; Binary Tree; Matrix Representation of Graphs (Adjacency and Incidence Matrices);

TEXT BOOKS

1. Kreyszig.E, Advanced "*Engineering Mathematics*",10th edition, John Wiley & Sons, Singapore, 2012.
2. Veerajan T., Discrete "*Mathematics*" with Graph Theory and Combinatorics", 10th edition,Tata McGraw Hill Companies,2010.

REFERENCES

1. Grewal B.S, Higher "*Engg Maths*", Khanna Publications, 42nd Edition,2012..
2. Miller I.R. and Freund J.E., Probability and Statistics for Engineers, Prentice Hall, 5th edition,1995
3. Kandasamy P etal. "*Engineering Mathematics*", Vol. II & Vol. III (4th revised edition), S.Chand & Co., New Delhi, 2000
4. Narayanan S., Manicavachagom Pillay T.K., Ramanaiah G., Advanced "*Mathematics for Engineering students*", Volume II & III (2nd edition), S.Viswanathan Printers and Publishers, 1992
5. Venkataraman M.K., "*Engineering Mathematics*" - Vol.III - A & B (13th edition), National Publishing Co., Chennai, 1998

MA1033 MATHEMATICS FOR BIOMEDICAL ENGINEERING												
Course designed by		**Department of Mathematics**										
1	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		X				**X**						
2	Mapping of instructional objectives with student outcome	**1-5**				**1-5**						
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)		
				X								
4	Approval	23rd meeting of academic council, May 2013										

BM1003	**BASICS OF HUMAN ANATOMY AND PHYSIOLOGY**	**L**	**T**	**P**	**C**
	Total contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

To understand clearly and identify the various parts of the human body, their anatomical position, their functions and how these can be used in the design of effective biomedical systems.

INSTRUCTIONAL OBJECTIVES	
1.	To learn basics of human body, cell, and blood
2.	To study about the positioning and functioning of the cardiovascular and respiratory systems
3.	To study about the positioning and functioning of the nervous system and musculoskeletal system
4.	To study about the positioning and functioning of the digestive and excretory system
5.	To study about the positioning and functioning of the special organs and endocrine glands

UNIT I - INTRODUCTION HUMAN BODY -CELL, BLOOD (8 Hours)

Overview of organ systems, Basic terminologies (Directional, regional, planes, feedback) - Cell: Different types of cells, Cell Structure and its organelles - Functions of each component in the cell - Membrane – transport across membrane - Origin of cell membrane potential - Action potential and propagation - Blood-Composition-RBC, WBC and Platelets.

UNIT II - CARDIOVASCULAR AND RESPIRATORY SYSTEMS (9 Hours)

Structure of heart -Circulation types - Cardiac cycle- Volume and pressure changes - ECG - Heart sounds - Blood pressure -Regulation of BP - Parts of respiratory system , Mechanics of respiration - Carbon dioxide and oxygen transport - Regulation of respiration - Volumes and capacities of lung, Types of hypoxia

UNIT III - NERVOUS SYSTEM AND MUSCULOSKELETAL SYSTEM (9 Hours)

Nerve cell anatomy -Functions of nervous system - Brain anatomy and hemispheres –Meninges - Cerebro Spinal Fluid-Circulation and Absorption-Spinal cord anatomy - Reflex action-PNS - Skeletal System -Functions -Anatomy of long bone –Formation, growth and repair - Structural and functional classification of joints - Functions of muscular system –Types of muscles - Sliding Filament Model - Neuromuscular junction - Physiology of muscle contraction

UNIT IV - DIGESTIVE AND EXCRETORY SYSTEM (9 Hours)

Digestive system-Organization -Movements of GI tract - Digestion at various parts (Mouth to Large Intestine) - Accessory organs of Digestion(Salivary glands, Liver, Pancreas, Gall Bladder)– Defecation - Excretory System - Functions of urinary system - Microanatomy and functions of nephron - Physiology of urine formation – Micturition

UNIT V - SPECIAL ORGANS AND ENDOCRINE GLANDS (10 Hours)

Eyes-retina Layers, Visual Pathway - Internal ear-Physiology-Auditory Pathway - Sense of Taste - Sense of Smell, touch - Endocrine glands-different glands and their hormones - Pituitary, Thyroid Parathyroid glands-Secretions - Maintenance of Calcium homeostasis - Maintenance of glucose homeostasis

TEXT BOOKS

1. Arthur.C.Guyton, John E Hall, "*Textbook of Medical Physiology*", W.B. Saunders Company, Twelfth edition, 2006

REFERENCES

1. Sarada Subramanyam, K.Madhavan Kutty and H.D.Singh "*Text Book of 'Human Physiology*" - S.Chand & Company, First Edition,1996
2. Ranganathan, T.S. "*Text Book of Human Anatomy*" , S.Chand &Co. Ltd.,Fifth Edition ,1996
3. Ross & Wilson, Anatomy & Physiology for Health and Illness, Elsevier, 11th Edition, 2010.

BM1003 BASICS OF HUMAN ANATOMY AND PHYSIOLOGY												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
					X							
2	Mapping of instructional objectives with student outcome				**1 - 5**							
3	Category	General (G)			Basic Sciences (B)			Engineering Sciences and Technical Arts (E)			Professional Subjects (P)	
											X	
4	Broad area (for 'P'category)	Biomedical Electronics Engg			Basics of Biomedical Engg		Biomedical Instrumentation Engg		Biomedical Imaging Engg		Health care Engg	
					X							
5	Approval	23rd meeting of Academic Council, May 2013										

EC1007	DIGITAL SYSTEMS	L	T	P	C
	Total contact Hours - 45	3	0	0	3
	Prerequisite				
	Basic knowledge of logic gates and its truth table				

PURPOSE

The purpose of this course is to develop a strong foundation in analysis and design of digital electronics.

INSTRUCTIONAL OBJECTIVES

1.	Understand concepts of combinational and sequential circuits.
2.	Analyze the synchronous and asynchronous logic circuits.
3.	Understand concepts of memory, programmable logic and digital integrated circuits.
4.	Design Combinational and sequential systems.

UNIT I-BASIC CONCEPTS, BOOLEAN ALGEBRA, THEOREMS AND FUNCTIONS (10 hours)

Number Systems: Decimal number system, binary number system, octal number system , hexadecimal number system, BCD number system, Excess-3 code, Gray code, Alpha numeric code, error detecting and error correcting codes.

Arithmetic: Arithmetic number representation, Binary arithmetic, Hexadecimal arithmetic, BCD arithmetic.

Boolean Algebra and Theorems: Logic gates and logic operations, Boolean theorems and postulates, SOP's & POS's, Minterms and Maxterms.

Minimization of Boolean Functions: Algebraic simplification, Karnaugh map simplification, Quine-Mc Cluskey or Tabulation method.

UNITII-LOGIC GATES (9 hours)

Logic Families: Metal Oxide Semiconductor logic families- switching properties of NMOS and PMOS transistors, static NMOS, dynamic NMOS, Static CMOS and dynamic CMOS logic families, CMOS Transmission gate circuits, Bipolar logic families- switching properties of NPN and PNP transistors, TTL, Schottkey TTL, Comparison of MOS logic circuits(CMOS) with that of a TTL digital circuit, Tristate gates.

Electrical characteristics: Meanings of speed, propagation delay, operating frequency, and power dissipated per gate, supply voltage levels, operational voltage levels of various logic families.

UNIT III-COMBINATIONAL SYSTEMS (9 hours)

Binary arithmetic units (Adder, Subtractor, n-bit parallel adder & Subtractor, look ahead carry generator), decoder, encoder, multiplexer, Demultiplexer, code converters, Magnitude comparators, parity generators. Implementation of combinational logic by standard IC's.

UNIT IV-SEQUENTIAL SYSTEMS (10 hours)

Flip-flop and Latch: SR latch, JK flip-flop, T flip-flop, D flip-flop and latch, Master-slave RS flip-flop, Masterslave JK flip-flop, asynchronous inputs.

Registers & Counters: Shift registers (SISO, SIPO, PISO, PIPO), universal shift register. CountersAsynchronous/Ripple counters, Synchronous counters, Modulus-n Counter, Ring counter, Johnson counter, UpDown counter, asynchronous clear, preset and load in a counter, synchronous clear, preset and load in a counter, typical IC's for counters.

Synchronous (Clocked) sequential circuits: Moore and Mealey state machine circuits, Analysis & design of synchronous sequential circuits – State machine design with SM charts.

UNIT V-MEMORY AND PROGRAMMABLE LOGIC (7 hours)

RAM, memory decoding, ROM, PROMs, PAL & PLA, Sequential Programmable Devices (discuss three major devices without going into their detailed construction).

TEXT BOOKS

1. Morris Mano, "*Digital Design"*, Prentice Hall of India, Fourth edition, 2009.
2. Ronald J. Tocci, Neal S.Widmer, Gregory L.Moss, "*Digital System Principles and Applications",* PHI, Eleventh Edition, 2010.

REFERENCES

1. CharlesH.Roth*, "Fundamentals Logic Degisn"*, Jaico Publishing, Fourth Edition, 2002.
2. Floyd, "*Digital Fundamentals"*, Universal Book stall, New Delhi, 8th Impression, 2009.
3. Malvino.A.P. and Donald.P.Leach, "*Digital Principal and Applications"* Tata McGraw Hill, Fourth edition, 1999.
4. Tokheim "*Digital electronics principles and applications"*, Tata McGraw Hill, Sixth edition 2004.

EC1007 DIGITAL SYSTEMS												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		X	**X**	**X**								
2	Mapping of instructional objectives with student outcome	1,2,4	**1-4**	1 - 4								
3	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
										x		
4	Broad area (for 'P'category)	Biomedical Electronics Engg		Basics of Biomedical Engg			Biomedical Instrumentation Engg		Biomedical Imaging Engg		Health care Engg	
		X										
5	Approval	23rd meeting of Academic Council, May 2013										

EC1012	**ELECTRONIC CIRCUITS**	**L**	**T**	**P**	**C**
	Total contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

The purpose of this course is to introduce to the students the basics of biasing transistor circuits, feedback amplifiers, large signal amplifiers, tuned amplifiers, oscillators, wave shaping circuits, and to design and analyze various electronic circuits and systems

INSTRUCTIONAL OBJECTIVES

1.	Operating point calculations, working and design of basic amplifiers, power amplifiers and tuned amplifiers
2.	Working of different types of feedback amplifiers & oscillators.
3.	Frequency response and design of tuned amplifiers.
4.	Basic working & design of wave shaping circuits.
5.	

UNIT I-BIASING CIRCUITS AND SMALL SIGNAL MODELS (9 hours)

Biasing circuits: DC load line and bias point – BJT biasing circuits – FET biasing circuits. Small-signal models: AC load line, BJT models and parameters – hybrid equivalent model – hybrid ∏ model, FET small-signal model and parameters.

UNIT II-SMALL-SIGNAL AMPLIFIERS - ANALYSIS AND FREQUENCY RESPONSE (9 hours)

BJT amplifiers : CE, CB and CC amplifiers – multistage amplifiers - differential amplifier – designing BJT amplifier networks.(analysis using hybrid –π model) FET amplifiers : CS, CG and CD amplifiers –designing FET amplifier networks.

Frequency response: low frequency response of BJT and FET amplifiers – Miller effect capacitance – high frequency response of BJT and FET amplifiers.

UNIT III-FEEDBACK AND OSCILLATOR CIRCUITS (9 hours)

Feedback circuits: concept of feedback – effects of negative feedback – feedback connection types – practical feedback circuits – phase and frequency considerations – designing feedback amplifier circuits. Oscillator circuits:

Oscillator principles – LC oscillators – RC oscillators – crystal oscillators – designing oscillator circuits.

UNIT IV-POWER AMPLIFIERS AND TUNED AMPLIFIERS (9 hours)

Power amplifiers : definitions and amplifier types – Q point placement – maximum dissipation hyperbola – Class A amplifier – Class B and Class AB push-pull amplifiers – Class C amplifiers – Amplifier distortions – heat sink – designing power amplifier circuits.

Tuned amplifiers: need for tuned circuits – single tuned – double tuned – synchronously tuned amplifiers – impedance matching to improve gain – design of basic tuned amplifier – video amplifier circuits (CA3040).

UNITV-SOLID STATE SWITCHING CIRCUITS (9 hours)

Types of waveforms – transistor switching times – Multivibrators – Astable Multivibrator – Monostable multivibrator – bistable multivibrator – Schmitt trigger – design of multivibrators and Schmitt trigger.

TEXT BOOKS

1. Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory”, Pearson Education, 9th Edition, 2009.
2. David A Bell, “Fundamentals of Electronic Devices and Circuits”, Oxford University Press, 2009.
3. David A. Bell, “Solid State Pulse Circuits”, Oxford University Press, 2007.

REFERENCES

1. Jacob Millman, Christos C Halkias, Satyabrata Jit, “Electron Devices and Circuits”, Tata McGraw Hill, 2010.
2. Thomas L. Floyd, “Electronics Devices”, 9th edition, Pearson Education, 2011.

3. Albert P. Malvino, David J. Bates, “Electronic Principles”, 7th edition, Tata McGraw Hill, 2007.

EC1012 ELECTRONICS CIRCUITS												
Course designed by		Department of Biomedical Engineering										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		X	X	X		X						
2	Mapping of instructional objectives with student outcome	1-4	1-4	1-4								
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)		Professional Subjects (P)				
								X				
4	Broad area (for ‘P’category)	Biomedical Electronics Engg		Basics of Biomedical Engg		Biomedical Instrumentation Engg		Biomedical Imaging Engg		Health care Engg		
		X										
5	Approval	23rd meeting of Academic Council, May 2013										

BM1006	BIOMEDICAL SENSORS AND MEASUREMENT DEVICES	L	T	P	C
	Total contact Hours – 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To gain knowledge about the measuring instruments and the methods of measurement.

INSTRUCTIONAL OBJECTIVES

1.	To get the basic idea of measurements and the errors associated with measurement.
2.	To know about the various types of transducers.
3.	To understand the function of signal generators and analyzers.
4.	To gain knowledge on functioning of the various measuring instruments, display devices and application on the biomedical devices.

UNIT I - MEASUREMENT SYSTEM AND BASICS OF TRANSDUCER (9 Hours)

Measurements and generalized measurement system: Static characteristics, accuracy, precision, linearity, hysteresis, threshold, dynamic range- Dynamic Characteristics-calibration, standards and AC/DC bridges, Transducer: Basics, Classification, Characteristics and Choice, POT, Thermistor, Thermocouple, Temperature compensation.

UNIT II - MEASUREMENT OF NON-ELECTRICAL QUANTITIES (9 Hours)

LVDT, Strain gauges, Transducer: Pressure, Capacitive, Inductive, Electrochemical, Piezo-electric, Hall effect, Opto-electronic Digital encoding/digital, Fiber-optic, Flow and liquid level, and Electrochemical transducer.

UNIT III - SIGNAL GENERATORS AND SIGNAL ANALYZER (9 Hours)

Signal generator: AF, Pulse, AM, FM, Function, and Sweep frequency generator, Signal analyzer Wave, Spectrum, Logic, and Distortion analyzer.

UNIT IV - DIGITAL DATA DISPLAY AND RECORDING SYSTEM (9 Hours)

DVM and millimeters, Frequency, Period measurement, Time interval and pulse width measurement, Graphic recorders-strip chart, X-Y recorder, Magnetic tape recorder, CRO basics: CRT, General purpose oscilloscope, Dual trace, Dual beam, Sampling oscilloscope, Digital storage oscilloscope.

UNIT V - MEDICAL APPLICATIONS OF SENSORS (9 Hours)

Gas sensor, Microbial sensor, electro analytical sensor, Enzyme based sensor--Glucose sensor, Electronic nose- halitosis, Advances in sensor technology: Lab-on-a –chip, Smart sensor, MEMS and Nano sensor.

TEXT BOOKS

1. Sawhney A.K, "*A course in electrical and electronic measurements and instrumentation"*, Dhanpat Rai & Co (P) Ltd, Educational and Technical Publishers, 1996.
2. Cooper, "*Electronic Instrumentation and Measurement techniques"* Prentice Hall of India, 1998

REFERENCES

1. Renganathan S, "*Transducer engineering"*, Allied Publishers Limited, 2003
2. Murty DVS, "*Transducer and instrumentation"*, PHI, second edition, 2008.
3. Manoj Kumar Ram, Venkat R. Bhethanabolta, "*Sensors for chemical and biological applications",* CRC press, 2010
4. Patranabis D, "*Sensors and transducers"*, PHI, Second Edition, 2004.

5. Jacob Fraden, "*Handbook of Modern Sensors: Physics, Designs and applications*", Third edition, Springer International, 2010.
6. Doeblin, "*Measurements Systems: Application and Design",* Tata McGraw-Hill, 2003
7. Neubert HKP, "*Instrument Transducers*", Oxford University Press, 1999
8. Bakshi U.A, Bakshi A.V, "Measurement & Instrumentation" Technical Publication, 2nd Edition 2011.

BM1006 BIOMEDICAL SENSORS AND MEASUREMENT DEVICES												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
			X									**X**
2	Mapping of instructional objectives with student outcome		**1**									**4**
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)		
										X		
4	Broad area (for 'P'category)	Biomedical Electronics Engg		Basics of Biomedical Engg		Biomedical Instrumentation Engg			Biomedical Imaging Engg		Health care Engg	
		X										
5	Approval	23rd meeting of Academic Council, May 2013										

BM1007	**BIOMATERIALS AND ARTIFICIAL ORGANS**	**L**	**T**	**P**	**C**
	Total contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Basic knowledge of material science				

PURPOSE

To understand the principles and biology underlying the design of implants and artificial organs.

INSTRUCTIONAL OBJECTIVES

1.	To know about the different classes of materials used in medicine
2.	To gain knowledge about the application of biomaterials in medicine
3.	To understand the concept of biocompatibility and the methods of biomaterial testing
4.	To know about the technologies of biomaterial processing, clinical trials, ethical issues and regulatory standards.
5.	To gain knowledge in the existing designs of artificial organs.

UNIT I - BIOMATERIAL PROPERTIES (8 Hours)

Biomaterial –definition, Material characterization – Mechanical, thermal, Phase diagrams, Surface properties, Structure and properties of naturally occurring materials - Collagen, Bone, Teeth, Skin, Causes of failure - micro cracks, crazing, fatigue. Technologies of biomaterials processing - Surface coating methods

UNIT II - CLASSES OF BIOMATERIALS (10 Hours)

Different classes of materials used in medicine - Polymers – Synthesis -Mechanical & Thermal properties - Polyesters – Polyacrylates - Polyanhyrides - Biodegradable Polymers – Hydrogels – Elastomer – Dendrimers. Metals - Stainless steel - Cobalt-Chromium alloy - Titanium alloys. Ceramics and Bioglasses - nonabsorbable bioceramics - biodegradable ceramics -bioreactive ceramics - deterioration of ceramics - Other Bioactive materials, Composites as biomaterials

UNIT III - SOFT AND HARD TISSUE APPLICATIONS (9 Hours)

Sutures, Wound dressings, artificial skin - Drug delivery devices - Cardiovascular medical devices – Heart valves, Assist devices-Stent and grafts, Orthopedic fixation devices – Internal – External - Joints, Total Hip Arthroplasty – Evolution-Design.

UNIT IV - MATERIAL RESPONSE (8 Hours)

Material and Tissue interaction, biological environment and host response - Inflammation, Wound Healing and Foreign Body Response - Failure mechanisms; corrosion, fracture, degradation of Implanted Materials – Polymers,Metals,ceramics.

UNIT V - BIOMATERIAL TESTING AND ARTIFICIAL ORGANS (10 Hours)

Testing of biomaterials: In-vitro, In-vivo preclinical tests - biocompatibility – methods for improvement, surface modification of materials - implant retrieval and evaluation. eye and ear implants, artificial pancreas, ophthalmic implantation, dental implantation, insulin administration devices, extracorporeal artificial organs, neural prostheses.

TEXT BOOKS

1. Joon Bu Park, Roderic S. Lakes, "*Biomaterials*", Springer-Verlag, New York Inc., 2010.
2. Ratner B.D and Hoffman A.S, "*Biomaterials Science: An Introduction to Materials in Medicine"*, Academic Press; 3 edition,November 8, 2012.

REFERENCES

1. Chua P.K, Chena J Y, Wanga L.P, Huang N, "*Plasma-surface modification of biomaterials",* Materials Science and Engineering: R: Reports, Volume 36, Number 5, 29 March 2002, pp. 143-206 (64)

2. Sujata V. Bhat, '*Biomaterials',* Narosa publishing house Pvt Ltd ; 4th Edition, 2010.

BM1007 BIOMATERIALS AND ARTIFICIAL ORGANS													
Course designed by		**Department of Biomedical Engineering**											
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k	
				X			**X**					**X**	
2	Mapping of instructional objectives with student outcome			**4**			**4**					**5**	
3	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)			Professional Subjects (P)			
										X			
4	Broad area (for 'P'category)	Biomedical Electronics Engg		Basics of Biomedical Engg			Biomedical Instrumentation Engg			Biomedical Imaging Engg		Health care Engg	
												X	
5	Approval	23rd meeting of Academic Council, May 2013											

EC1010	**DIGITAL SYSTEMS LAB**	**L**	**T**	**P**	**C**
	Total contact Hours - 30	**0**	**0**	**3**	**2**
	Prerequisite				
	Nil				

PURPOSE

To provide the student with the capability to use simulation tools in digital electronic circuit analysis and design

INSTRUCTIONAL OBJECTIVES

1.	To develop necessary skill in designing, analyzing and constructing digital electronic circuits.
2.	To design and simulate digital logic circuits using tools such as Logisim or PSPICE or Multisim.

LIST OF EXPERIMENTS **(45 hours)**

1. Study of Gates & Flip-flops.
2. Half Adder and Full Adder.
3. Magnitude Comparator (2-Bit).
4. Encoders and Decoders.
5. Multiplexer and Demultiplexer.
6. Code Converters.

7. Implementation of combinational logic functions using standard ICs
8. Synchronous Counters.
9. Ripple Counter.
10. Mod – N Counter.
11. Shift Registers and Shift Register Counters.
12. Implementation of sequential logic functions using standard ICs.
13. Simulation Experiments using Logisim/PSPICE/multisim..

REFERENCES

1. LAB MANUAL", Department of ECE, SRM University
2. "Maheswari.L.K and Anand.M.M.S, "Laboratory Manual for Introductory Electronic Experiments", New Age, 2010.
3. Poornachandra Rao.S and Sasikala.B, "Handbook of Experiments in Electronics and Communication Engineering", Vikas publishers, 2003.
4. Website: http://ozark.hendrix.edu/~burch/logisim/

EC1010 DIGITAL SYSTEMS LAB												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
			X	**X**	**X**		**X**					**X**
2	Mapping of instructional objectives with student outcome		**1,2**	**1,2**			**1**					**2**
3	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
										x		
4	Broad area (for 'P'category)	Biomedical Electronics Engg		Basics of Biomedical Engg			Biomedical Instrumentation Engg		Biomedical Imaging Engg			Health care Engg
		X										
5	Approval	23rd meeting of Academic Council, May 2013										

BM1009	APPLIED ELECTRONIC CIRCUITS LAB	L	T	P	C
	Total contact Hours - 30	0	0	2	1
	Prerequisite				
	Nil				

PURPOSE

To gain practical knowledge about the fundamental characteristics of electronic circuits

INSTRUCTIONAL OBJECTIVES

1.	To know about some frequently used instruments and equipments like the digital multi-meter and DC power supply.
2.	To introduce the concept of active device, including operational amplifiers, and their use in amplification, signal conditioning, switching and filtering
3.	To learn current and voltage calculations in AC circuits.
4.	To get an expose to the practical applications of different types of oscillators and thermostats.
5.	To impart technical skills to construct and analyze transistor amplifiers

LIST OF EXPERIMENTS

1. Rectifier
2. Frequency Response of CE amplifier with self-bias
3. Power Amplifier - Efficiency Determination
4. LC Oscillators (Hartley and Colpitt)
5. R- C Phase Shift Oscillator
6. Mono-stable and Astable multi-vibrators
7. Frequency response. of Tuned Amplifier
8. Schmitt Trigger
9. Feedback Amplifier
10. Case study: Any one biomedical application of electronic circuit

The following National Instruments (NI) products will be used as a supplement:

- NI ELVIS Circuit Prototyping Hardware
- NI LabVIEW System Design Software
- NI Multisim Circuit Simulation Software
- NI Ultiboard PCB Design Software

REFERENCES

1. Applied Electronic Circuits Lab Manual

BM1009 APPLIED ELECTRONICS CIRCUITS LAB												
Course designed by		Department of Biomedical Engineering										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
			X									
2	Mapping of instructional objectives with student outcome		1									
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)		
										X		
4	Broad area (for 'P'category)	Biomedical Electronics Engg		Basics of Biomedical Engg		Biomedical Instrumentation Engg			Biomedical Imaging Engg		Health care Engg	
		X										
5	Approval	23rd meeting of Academic Council, May 2013										

BM1010	BIOMEDICAL SENSORS AND MEASUREMENT DEVICES LAB	L	T	P	C
	Total contact Hours - 30	0	0	2	1
	Prerequisite				
	Nil				

PURPOSE

To study and analyze the theory and practical characteristics of the various transducers for the measurement of the vital physiological signals.

INSTRUCTIONAL OBJECTIVES

To get familiar with the various types of transducers and to study the compatibility for any clinical measurements

LIST OF EXPERIMENTS

1. Characteristics of pressure transducer
2. Measurement of displacement capacitive transducer, LVDT and Inductive transducer
3. Characteristics of optical transducer for SpO_2 measurement
4. Measurement of skin temperature by both contact and non-contact method

5. Study of the characteristics of capacitor level sensor for saline level measurement in a I-V set.
6. Data acquisition of physiological signals
7. Study of hot-wire anemometry
8. Study of amperometric sensor for blood glucose measurement
9. Electronic weighing machine for the measurement of chemical compounds
10. Non-invasive gas analyzer as an electronic nose

REFERENCES

1. Biomedical Sensor and Measurements Laboratory Manual

BM1010 BIOMEDICAL SENSORS AND MEASUREMENT DEVICES LAB												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
			X									**X**
2	Mapping of instructional objectives with student outcome		**1**									**4**
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)		
										X		
4	Broad area (for 'P'category)	Biomedical Electronics Engg		Basics of Biomedical Engg		Biomedical Instrumentation Engg		Biomedical Imaging Engg		Health care Engg		
		X										
5	Approval	23rd meeting of Academic Council, May 2013										

SEMESTER IV

LE1008	**GERMAN LANGUAGE PHASE II**	**L**	**T**	**P**	**C**
	Total contact Hours - 30	**2**	**0**	**0**	**2**
	Prerequisite				
	LE1003- German Language Phase I				

PURPOSE

Familiarity in German language will be helpful for the students in preparing their resumes in German. Proficiency in the language will be an added asset for the students to have an edge in the present day highly competitive and global job market.

INSTRUCTIONAL OBJECTIVES

1.	To enable the students to speak and understand about most of the activities in the day to day life.
2.	The students will be able to narrate their experiences in Past Tense.
3.	The students will be able to understand and communicate even with German Nationals.
4.	By the end of Phase – II the students will have a reasonable level of conversational skills.

UNIT I **(6 Hours)**

Wichtige Sprachhandlungen: Zimmersuche, Möbel

Grammatik: Verben mit trennbaren Vorsilben im Präsens und Perfekt. Verben mit trennbaren Vorsilben und Modalverben imPräsens. Verben mit untrennbaren Vorsilben im Perfekt. Unregelmäßige und gemischte Verben im Perfekt.

UNIT II **(6 Hours)**

Wichtige Sprachhandlungen: Kleidung ,Farben , Materialien.

Grammatik : formelle Imperativsätze mit “Sie” informelle Imperativsätze Vorschläge mit “wir” – “sollen/wollen wir”—Soll ich? Modalpartikeln “doch” “mal” “doch mal.

UNIT III **(6 Hours)**

Wichtige Sprachhandlungen : Sehenswürdigkeite (Prater, Brandenburger Tör,Kolossium, Eifeltürm)

Grammatik : Ortsangaben mit Akk. und Dativ “alle”,”man” Indefinitepronomen “etwas”, “nichts”,

UNIT IV **(6 Hours)**

Wichtige Sprachhandlungen : Wegbeschreibung/ Einladung interkulturelle Erfahrung.

Grammatik : Verwendung von Präsens für zukünftigen Zeitpunkt.

UNIT V **(6 Hours)**

Wichtige Sprachhandlungen: Essen und Trinken im Restaurant , Partyvorbereitung und Feier

Grammatik: Nomen aus Adjektiven nach "etwas"und "nichts" Nomen aus dem Infinitiv von Verben, zusammegesetzte Nomen und ihre Artikel. Adjektive im Nom. und Akk. nach unbestimmten Artikel, Negativartikel und Possessivartikel.

TEXT BOOK

1. Studio d A1.Deutsch als Fremdsprache with CD. (Kursbuch und Sprachtraining)

REFERENCES

1. German for Dummies
2. Schulz Griesbach

LE01008 GERMAN LANGUAGE PHASE II													
Course designed by		**Department of English and Foreign Languages**											
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k	
								x					
2	Mapping of instructional objectives with student outcome							**1-4**					
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)			
		X											
4	Approval	23rd meeting of Academic Council, May 2013											

LE1009	**FRENCH LANGUAGE PHASE II**	**L**	**T**	**P**	**C**
	Total contact Hours- 30	**2**	**0**	**0**	**2**
	Prerequisite				
	LE1004- French Language Phase I				

PURPOSE

To enable the students communicate effectively with any French speaker and have a competitive edge in the international market.

INSTRUCTIONAL OBJECTIVES

1.	To enable students access information on the internet
2.	To receive and send e mails
3	To assist students in gaining a certain level of proficiency to enable them to give the level 1 exam conducted by Alliance Française de Madras.
4.	To enhance their lexical and technical competence.

UNIT I **(6 Hours)**

A. Grammar and Vocabulary: The second group verbs: Finir, rougir, grossir, grandir . "Les preposition de temps": à, en, le, de 7h à 8h, jusqu' à, vers.
B. Listening and Speaking – the semi- vowels: Voilà, pollutant.
C. Writing –the days of the week. Months, technical subjects, time, "les spécialités scientifiques et l' année universitaire, paragraph writing about time table.
D. Reading -- Reading of the text and comprehension – answering questions .

UNIT II **(6 Hours)**

Grammar and Vocabulary – The adjectives, the nationality, feminine & masculine noun forms "les métiers scientifiques".
Listening and Speaking – Vowels: soirée, année, près de, très.
Writing – Countries name, nationality, "les métiers scientifiques", numbers from: 69 to infitive and some measures of unit.
Reading Comprehension – reading a text.

UNIT III **(6 Hours)**

Grammar and Vocabulary – near future, The demonstrative adjectives, Express the aim by using the verb,
Listening and Speaking –"La liaison interdite – en haut".
Writing – some scientific terms, French expressions to accept an invitation. Sentence framing.
Reading Comprehension – reading a text.

UNIT IV **(6 Hours)**

Grammar and Vocabulary –the verbs: manger, boire , the partitive articles
Listening and Speaking – "le 'e' caduc
Writing- the food, the ingredients, fruits, vegetables, expression of quantity, paragraph writing about food habits.
Reading – reading a text.

UNIT V **(6 Hours)**

Grammar and Vocabulary – " les prepositions de lieu": au à la, à l', chez, the reflexives verbs, verbs to nouns.
Listening and Speaking – "le 'e' sans accents ne se prononce pas. C'est un "e" caduc. Ex: quatre, octobre. " les sons (s) et (z)- salut , besoin.
Writing –paragraph writing about one's everyday life, French culture.
Reading Comprehension -- reading a text or a song.....

TEXT BOOK

1. Tech French

REFERENCES

1. French for Dummies.
2. French made easy: Goyal publishers

LE1009 FRENCH LANGUAGE PHASE II												
Course designed by		**Department of English and Foreign Languages**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
								X				
2	Mapping of instructional objectives with student outcome							**1-4**				
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)		
		X										
4	Approval	23rd meeting of Academic Council, May 2013										

		L	T	P	C
LE1010	**JAPANESE LANGUAGE PHASE II**				
	Total contact Hours - 30	**2**	**0**	**0**	**2**
	Prerequisite				
	LE 1005- Japanese Language Phase-II				

PURPOSE

To enable students to learn a little advanced grammar in order to improve their conversational ability in Japanese.

INSTRUCTIONAL OBJECTIVES

1.	To help students learn Katakana script (used to write foreign words)
2.	To improve their conversational skill.
3	To enable students to know about Japan and Japanese culture.
4.	To improve their employability by companies who are associated with Japan.

UNIT I **(8 Hours)**

Introduction to Verbs; Ikimasu, okimasu, nemasu, tabemasu etc.
Grammar – usage of particles de, o, to, ga(but) and exercises
Common daily expressions and profession.
Katakana script and related vocabulary.
Religious beliefs, Japanese housing and living style.

Conversation – audio

UNIT II **(8 Hours)**

Grammar :Verbs –Past tense, negative - ~mashita, ~masen deshita..
i-ending and na-ending adjectives - introduction
Food and transport (vocabulary)
Japanese food, transport and Japanese tea ceremony.
Kanji Seven elements of nature (Days of the week)
Conversation – audio

UNIT III **(6 Hours)**

Grammar - ~masen ka, mashou
Adjectives (present/past – affirmative and negative)
Conversation – audio

UNIT IV **(4 Hours)**

Grammar – ~te form
Kanji – 4 directions
Parts of the body
Japanese political system and economy
Conversation – audio

UNIT V **(4 Hours)**

Stationery, fruits and vegetables
Counters – general, people, floor and pairs

TEXT BOOK

1. First lessons in "*Japanese*", ALC Japan

REFERENCES

1. Japanese for dummies.Wiley publishing co.Inc.,USA.
2. Kana workbook, Japan foundation

LE1010 JAPANESE LANGUAGE PHASE II												
Course designed by		**Department of English and Foreign Languages**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
								X				
2	Mapping of instructional objectives with student outcome							1to 4				
3	Category	General (G)	Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)				
		X										
4	Approval	23rd meeting of Academic Council, May 2013										

LE1011	**KOREAN LANGUAGE PHASE II**	**L**	**T**	**P**	**C**
	Total contact Hours-30	**2**	**0**	**0**	**2**
	Prerequisite				
	LE1006-Korean Language Phase I				

PURPOSE

To enable students achieve a basic exposure on Korea, Korean language and culture. To acquire basic conversational skill in the language.

INSTRUCTIONAL OBJECTIVES

1.	To help students learn the scripts.
2.	To make the students acquire basic conversational skill.
3	To enable students to know about Korean culture.
4.	To create an advantageous situation for the students to have better opportunity for employability by companies who have association with Korea.

UNIT I **(9 Hours)**

Lesson 1 <Review of Vowels and Consonants>, Lesson2 < Various Usages of "To be">, Lesson3 < Informal form of "to be"> <Basic Conversation, Vocabularies and Listening>

UNIT II **(9 Hours)**

Lesson 4 < Informal interrogative form of "to be">, Lesson 5 < To be, to have, to stay>, Lesson 5 < Advanced Interrogative practice>, Lesson 6 < Types of Negation>, <Basic Conversation, Vocabularies and Listening>

UNIT III **(9 Hours)**

Lesson 7 < Honorific forms of noun and verb2>, Lesson8 < Formal Declarative2>, Lesson 9 < Korean Business Etiquette>, <Basic Conversation, Vocabularies and Listening>

UNIT IV **(3 Hours)**

Lesson 10 <Field Korean as an Engineer1>, <Field Korean as an Engineer2> , <Basic Conversation, Vocabularies and Listening>

TEXT BOOK

1. Korean through English 2 (Basic "*Korean"* Grammar and Conversation)

REFERENCES

1. Bharati *"Korean*" (Intermediate Korean Grammar)
2. Hand-outs
3. Various visual mediums such Movie CD, Audio CD, and music
4. Collection of vocabularies for engineering field.

<table>
<tr><td colspan="13">LE1011 KOREAN LANGUAGE PHASE II</td></tr>
<tr><td colspan="2">Course designed by</td><td colspan="11">Department of English and Foreign Languages</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Student outcome</td><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td>g</td><td>h</td><td>i</td><td>j</td><td>k</td></tr>
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<tr><td>4</td><td>Approval</td><td colspan="11">23rd meeting of Academic Council, May 2013</td></tr>
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LE1012	CHINESE LANGUAGE PHASE II	L	T	P	C
	Total contact Hours-30	2	0	0	2
	Prerequisite				
	LE1007 -Chinese Language Phase I				

PURPOSE

To enable students achieve a basic exposure on China, Chinese language and culture. To acquire basic conversational skill in the language.

INSTRUCTIONAL OBJECTIVES

1.	To help students learn the Chinese scripts.
2.	To make the students acquire basic conversational skill.
3.	To enable students to know about China and Chinese culture.
4.	To create an advantageous situation for the students to have better opportunity for employability by companies who have association with china.

UNIT I

A) Greetings
Questions and answers about names
Introducing oneself
Receiving a guest
Making corrections

New words: 你（you） 好（good, well）
工作（work, job）人员（personnel, staff member） 请问（May I ask…）
贵（expensive , valuable） 姓（one's family name is ）

B) Questions and answers about the number of people in a family
Expressing affirmation/negation
Questions and answers about the identity of a person same or not.

New words: 家（family, home） 有（have） 几（several）
爸爸 (father) 妈妈 (mother) 哥哥 (elderly brother）

UNIT II

A. About places
B. About numbers
C. if one knows a certain person
D. Expressing apology
E. Expressing affirmation/negation
F. Expressing thanks.

New Words:
客人（guest,visitor）这儿（here）中文（Chinese） 对（right, correct）
学生（student） 多（many, a lot）
Grammar: Sentences with a verbal predicate

UNIT III
Introducing people to each other
A. Exchanging amenities
B. Making/Negating conjectures
C. Questions and answers about nationality
Grammar: Sentences with an adjectival predicate

UNIT IV
A) About places to go
Indicating where to go and what to do
Referring to hearsay.
Saying good-bye
B) Making a request
Questions and answers about postcodes and telephone numbers
Reading dates postcodes and telephone numbers
Counting Renmibi
Grammar: Sentences with a subject-verb construction as its predicate
Sentences with a nominal predicate

UNIT V
B. Asking and answering if someone is free at a particular time
C. Making proposals
D. Questions about answers about time
E. Making an appointment
F. Telling the time
G. Making estimations

TEXT BOOK
1. A New "*Chinese Course 1- Beijing Language and Culture University*" Press

REFERENCES
1. New Practical "*Chinese Reader Textbook (1) – Beijing Language and Culture University*" Press
2. 40 Lessons For "*Basic Chinese Course*" I – Shanghai Translation Press
3. My "*Chinese Classroom - East China Normal University*" Press

LE1012 CHINESE LANGUAGE PHASE II												
Course designed by		**Department of English and Foreign Languages**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
								X				
2	Mapping of instructional objectives with student outcome							1 to 4				
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)		Professional Subjects (P)				
		X										
4	Approval	23rd meeting of Academic Council, May 2013										

PD1004	**APTITUDE II**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	**1**	**0**	**1**	**1**
	Prerequisite				
	Nil				

PURPOSE

To enhance holistic development of students and improve their employability skills.

INSTRUCTIONAL OBJECTIVES

1. To improve verbal aptitude, vocabulary enhancement and reasoning ability of the student.

UNIT I **(6 Hours)**

Critical Reasoning – Essay Writing

UNIT II **(6 Hours)**

Synonyms – Antonyms - Odd Word - Idioms & Phrases

UNIT III **(6 Hours)**

Word Analogy - Sentence Completion

UNIT IV **(6 Hours)**

Spotting Errors - Error Correction - Sentence Correction

UNIT V **(6 Hours)**

Sentence Anagram - Paragraph Anagram - Reading Comprehension

ASSESSMENT

1. Objective type – Paper based /Online – Time based test

REFERENCES

1. Personality Development -Verbal Work Book, Career Development Centre, SRM Publications
2. Green Sharon Weiner M.A & Wolf Ira K. "*Barron's New GRE*, *19th Edition »*.Barron's Educational Series, Inc, 2011.
3. Lewis Norman, "*Word Power Made Easy*" , Published by W.R.Goyal Pub, 2011.
4. Thorpe Edgar and Thorpe Showich, *"Objective English"* . Pearson Education 2012.
5. Murphy Raymond, *"Intermediate English Grammar"*, (Second Edition), Cambridge University Press, 2012.

PD1004 APTITUDE II												
Course designed by		**Career Development Centre**										
1	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
								X				
2	Mapping of instructional objectives with student outcome							1				
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)		
		X										
4	Approval	23rd meeting of Academic Council, May 2013										

MA1044	NUMERICAL METHODS IN BIOMEDICAL ENGINEERING	L	T	P	C
	Total Contact Hours - 60	4	0	0	4
	Prerequisite				
	Nil				

PURPOSE

To impart analytical ability in solving mathematical problems as applied to the respective branches of Engineering.

INSTRUCTIONAL OBJECTIVES:

1.	To be familiar with numerical solution of equations
2.	To get exposed to finite differences and interpolation
3.	To be familiar with the numerical Differentiation and integration
4.	To find numerical solutions of ordinary differential equations
5.	To find numerical solutions of partial differential equations

UNIT I - CURVE FITTING AND NUMERICAL SOLUTION OF EQUATIONS (12 Hours)

Method of Least Squares – Fitting a straight line – Fitting a parabola – Fitting an exponential curve – Fitting a curve of the form $y = ax^b$ – Calculation of the sum of the squares of the residuals-Eigen value problems by Power method – Jacobi method.

UNIT II - FINITE DIFFERENCES AND INTERPOLATION (12 Hours)

First and Higher order differences – Forward differences and backward differences and Central Differences – Differences of a polynomial – Properties of operators – Factorial polynomials – Shifting operator E – Relations between the operators. Interpolation – Newton-Gregory Forward and Backward Interpolation formulae - Divided differences – Newton's Divided difference formula – Lagrange's Interpolation formula – Inverse interpolation.

UNIT III - NUMERICAL DIFFERENTIATION AND INTEGRATION (12 Hours)

Numerical Differentiation and Integration: Newton's forward and backward differences formulae to compute first and higher order derivatives – The Trapezoidal rule – Simpson's one third rule and three eighth rule.

UNIT IV- NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS

(12 Hours)

Solution by Taylor's series – Euler's method – Improved and modified Euler method – Runge-Kutta methods of fourth order (No proof) – Milne's Method - Adam's Bashforth method.

UNIT V- NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS **(12 Hours)**

Classification of Partial differential equations of the second order - Difference quotients – Laplace's equation and its solution by Liebmann's process – Solution of Poisson's equation – Solutions of Parabolic and Hyperbolic equations.

TEXT BOOK

1. B.S. Grewal, "*Numerical Methods in engineering and science*", Khanna Publishers, 42nd edition,2012.

REFERENCES

1. Venkataraman M.K, "*Numerical Methods in Science and Engineering",* National Publishing Co., 2005.
2. S.S. Sastry, "*Introductory Methods of Numerical Analysis*", 4th edition,2005.
3. Balagurusamy E, "*Computer Oriented Statistical and Numerical Methods*" – Tata McGraw Hill., 2000.
4. Jain M.K, Iyengar SRK and Jain RL, "*Numerical Methods for Scientific and Engineering Computation*," Wiley Eastern Ltd., 4th edition,2003
5. P.Kandasamy etal., "*Numerical Methods*", S.Chand & Co., New Delhi, 2003.

MA1044 NUMERICAL METHODS IN BIOMEDICAL ENGINEERING												
Course designed by		**Department of Mathematics**										
1	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		X				**X**						
2	Mapping of instructional objectives with student outcome	**1-5**				**1-5**						
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)		
				X								
4	Approval	23rd meeting of academic council, May 2013										

BM1011	MEDICAL INSTRUMENTATION-I	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite:				
	Basic knowledge of electronic devices, and physiological system				

PURPOSE

To gain basic knowledge about Bio potentials, Bio electrodes and bio amplifiers and to give a complete exposure of various recording mechanism and to understand the basic principles, working of biomedical instruments.

INSTRUCTIONAL OBJECTIVES

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

UNIT I - BIOELECTRODES AND BIOCHEMICAL SENSORS (10 Hours)

Components of Medical Instrumentation – System Origin of Bio potential: Action Potential, Nernst Equation, Goldman equation, Hodgkin- Huxley model - Electrode electrolyte interface, Half-cell potential, Polarisable and Non-polarisable electrodes - Skin electrode interface – Bio-electrodes: Surface-, Micro-. Needle- electrodes - Equivalent circuits of electrodes – Biochemical-, and Transcutaneous- electrodes: pH, pO_2, pCO_2 - Ion sensitive Field effect Transistors.

UNIT II - BIOAMPLIFIERS, BIOELECTRIC SIGNALS, PCG AND THEIR RECORDING

(8 Hours)

Bioamplifiers- Carrier Amplifier, - Isolation Amplifier - Differential amplifier - Chopper Amplifier - Instrumentation Amplifier - Bioelectric signals (ECG, EMG, EEG, EOG & ERG) and their characteristics - Electrodes for ECG, EEG and EMG - Einthoven triangle, Standard 12-lead configurations - ECG Machine - EMG machine – 10-20 electrodes placement system for EEG - EEG machine - Heart sound and characteristics, PCG

UNIT III - PATIENT MONITORING SYSTEMS AND BIOTELEMETRY (8 Hours)

Measurement of Blood pressure – Direct Methods and Indirect Methods - Temperature - Respiration rate - Heart rate measurement - Oximetry -Pulse oximeter, Ear oximeter - Computerized patient monitoring system – Bedside, Central Monitoring system – Biotelemetry: Basics components, and its different types.

UNIT IV - CARDIAC MEASUREMENTS AND ASSIST DEVICES (10 Hours)

Cardiac output Measuring techniques – Dye Dilution method, Thermo dilution method, BP method - Blood Flow measuring Techniques: Electromagnetic Type - Ultrasound Blood Flow meter, Laser Doppler Blood Flow meter - Cardiac Arrhythmias – Plethysmography - Cardiac Pacemakers – Defibrillator: AC-, and DC- types - Heart-Lung Machine (HLM) - Oxygenators

UNIT V - ANALYTICAL EQUIPMENTS (9 Hours)

Chemical Fibro sensors, Fluorescence sensors - Blood cell counters - Coulter counter, Electrical Impedance Method , Optical Method - Colorimeter, Spectro photometer, Flame photometer – Chromatography - Mass Spectrometer – Biochemical and Bioanalytical equipments Electrical hazard – Micro- and Macro-shock - Patient safety procedures

TEXT BOOKS

1. Geoddes L.A and Baker L.E, "*Principles of Applied Biomedical Instrumentation",* John Wiley, 3rd Edition, 1975, Reprint 1989.
2. Khandpur R.S, *"Hand-book of Biomedical Instrumentation",* Tata McGraw Hill, 2nd Edition, 2003.
3. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, *"Biomedical Instrumentation and Measurements"*, Prentice-Hall India, 2nd Edition, 1997

REFERENCES

1. R. Stuart MacKay, "*Bio-Medical Telemetry: Sensing and Transmitting Biological Information from Animals and Man",* Wiley-IEEE Press, 2nd Edition, 1968.
2. John G. Webster, "Medical *Instrumentation application and design*", John Wiley, 3rd Edition, 1997.
3. Carr, Joseph J, Brown, John M., *"Introduction to Biomedical equipment technology",* John Wiley and sons, New York, 4th Edition, 1997.
4. Geddes L.A and Baker L.E, "*Principles of Applied Biomedical Instrumentation",* John Wiley-Inter Science, 3rd Edition, 1989.
5. C.Rajarao and S.K. Guha, *"Principles of Medical Electronics and Bio-medical Instrumentation",* Universities press (India) Ltd, First Edition, Orient Longman Ltd, 2001.

BM1011 MEDICAL INSTRUMENTATION-I												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
			X									**X**
2	Mapping of instructional objectives with student outcome		**4**									**5**
3	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)				Professional Subjects (P)	
											X	
4	Broad area (for 'P'category)	Biomedical Electronics Engg		Basics of biomedical Engg			Biomedical Instrumentation Engg			Biomedical Imaging Engg		Health care Engg
							X					
5	Approval	23rd meeting of Academic Council, May 2013										

	BIOMEDICAL CIRCUITS AND NETWORKS	L	T	P	C
BM1012	Total contact Hours - 60	**3**	**1**	**0**	**4**
	Prerequisite				
	Basic knowledge of calculus, linear algebra & differential equations				

PURPOSE

To enable the students to acquire knowledge about the basics of circuit analysis, network theorems and AC circuits.

INSTRUCTIONAL OBJECTIVES

1.	To understand the basic methods of circuit analysis using Mesh & Nodal Analysis
2.	To understand the various Network theorem and apply them in biomedical circuits
3.	To get an insight into solution of RLC circuits as well as Analysis of coupled circuits
4.	To understand the concept of complex frequency and Total responses of RL, RC & RLC circuits
5.	To Analyze the two Port network parameters and Stability of Network

UNIT I - METHODS OF ANALYSING CIRCUITS WITH INDEPENDENT SOURCES (12 Hours)

Introduction: Tree and Co-Tree, Twigs and Links, Incidence Matrix, Link Current, Tie Set Matrix, Cut Set and Tree Branch Voltages, Mesh and Super mesh analysis, Mesh

equation by Inspection method, Nodal & Super Nodal Analysis, Nodal Equations by Inspection Method, Source Transformation Technique, Analyzing simple biomedical circuits

UNIT II - NETWORK THEOREMS (12 Hours)

Star-Delta Transformation, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Superposition Theorem, Compensation Theorem, Reciprocity theorem, Millman's theorem, Tellegen's theorem, Duals and Duality, Applying theorems in biomedical circuits.

UNIT III - AC CIRCUITS AND COUPLED CIRCUITS (12 Hours)

Power & Power factor, Series resonance-Q factor, Bandwidth, Parallel resonance-Q factor, Bandwidth, Self Inductance- Mutual Inductance - Coefficient of coupling, dot rule- effective inductance of coupled coils in series and parallel.

UNIT IV - TRANSIENT ANALYSIS (12 Hours)

Concept of complex frequency, Representation of network elements in time-, and frequency domain, Free and forced responses of RL, RC, RLC circuits with DC- and Sinusoidal- excitation

UNIT V - TWO PORT NETWORKS & ELEMENTS OF REALIZABILITY THEORY (12 Hours)

Network functions of one port and two port networks, Poles and Zeros of network functions, Two port Parameters: z, y, h, ABCD, Causality and Stability analysis of network functions, Hurwitz polynomial, Positive Real Functions.

TEXT BOOKS

1. Hayt, Kemmerley & Durbin, "*Engineering circuit Analysis"*, Tata McGraw Hill, 7th Edition 2008
2. Sudhakar A and Shyammohan S P, "*Circuits and Networks- Analysis and Synthesis"*, Tata McGraw Hill, 4th Edition 2010

REFERENCES

1. Franklin F. Kuo, "*Network Analysis and Synthesis"*, John Wiley & Sons, 2nd Edition Reprint 2009
2. Arumugam & Premkumar, "*Electric Circuit Theory"*, Khanna Publishers, First Edition 2002
3. Mahmood Nahvi & Joseph Edminister, "*Schaum's Outline of Electric circuits"*, McGraw-Hill Education, 5th edition 2011

4. Aatre .V.K, "*Network Theory and Filter Design*", New Age International Publishers, 2nd Edition Reprint 2003

BM1012 BIOMEDICAL CIRCUITS AND NETWORKS												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		X	**X**	**X**								
2	Mapping of instructional objectives with student outcome	**1 - 4**	**1**	**5**								
3	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)				Professional Subjects (P)	
											X	
4	Broad area (for 'P'category)	Biomedical Electronics Engg		Basics of biomedical Engg		Biomedical Instrumentation Engg			Biomedical Imaging Engg		Health care Engg	
		X										
5	Approval	23rd meeting of Academic Council, May 2013										

BM1013	**LINEAR INTEGRATED CIRCUITS**	**L**	**T**	**P**	**C**
	Total contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Basic knowledge of electronic circuits				

PURPOSE

To enable the students to understand the fundamentals of Integrated circuits and to implement it in biomedical applications.

INSTRUCTIONAL OBJECTIVES

1.	To understand and test the basic building blocks of linear integrated circuits.
2.	To familiarize the concepts of comparators, waveform generation and introduce some special function Ics.
3.	To study the basic concepts of data converters and voltage regulators and its practical application.
4.	To gain knowledge in the theory and applications of PLL and 555 Timer.
5.	To study the medical applications of linear and digital integrated circuits

UNIT I - FUNDAMENTALS OF OPERATIONAL AMPLIFIER AND ITS CHARACTERISTICS (9 Hours)

Introduction- Ideal Op-amp circuit – DC characteristics, AC characteristics –Basic Op-amp application, Instrumentation amplifier, V to I and I to V converter, Clipper, clamper, sample and hold, log amplifier ,differentiator, Integrator.

UNIT II - COMPARATORS, WAVEFORM GENERATORS AND ACTIVE FILTERS (9 Hours)

Introduction-basic comparator application, Regenerative comparator, monostable multivibrator , Astable multivibrator, Triangular wave generator, Theory of operation – Sine wave generator ,Wein bridge oscillator, Phase shift oscillator, sawtooth wave generator, RC active filter – Low pass, High pass filter, Band pass filter , notch filter.

UNIT III - DATA CONVERTERS AND VOLTAGE REGULATORS (9 Hours)

Digital / Analog – Basic concepts, General ADC and DAC specifications, Types of DAC-weighted, R-2R ladder, Inverted R-2R ladder , Types of ADC- Flash, Counter type, Successive approximation, Dual slope ADC, Op-amp voltage regulator-Series, Three terminal voltage regulator-specifications, 723 general-purpose voltage regulator

UNIT IV - PLL AND 555 TIMER (9 Hours)

PLL –working principle ,Voltage controlled oscillator(VCO), Application - frequency multiplier, frequency divider, Timer (IC555) – description of functional diagram, Functional diagram of Monostable operations – applications, Functional diagram of Astable operation, – applications.

UNIT V - MEDICAL APPLICATIONS OF LINEAR AND DIGITAL INTEGRATED CIRCUITS (9 Hours)

Application of Linear and digital integrated circuits – Digital thermometer, pulse oximetry, Blood pressure, Portable ECG measurement, Automatic External Defibrillator, Digital X-Ray, Endoscopy, Blood glucose monitor .

TEXT BOOKS

1. Roy Choudhury and Shail Jain, "*Linear Integrated circuits*", New Age International, 4th edition, 2010.
2. Coughlin & Driscoll, "*Operational Amplifiers & Linear Integrated Circuits*", Prentice Hall of India, 6th edition, 2003

REFERENCES

1. Gayakwad A.R, *Op-Amp and "Linear Integrated circuits",* Prentice Hall of India, 4th edition, 2003
2. Medical Applications guide-TI.com
3. Medical Instruments Guide-Ti.com
4. http://www.mouser.com/catalog/specsheets/TIsMedicalAppsGuide.pdf

BM1013 LINEAR INTEGRATED CIRCUITS												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
			X	**X**								
2	Mapping of instructional objectives with student outcome		**1**	**5**								
3	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
										X		
4	Broad area (for 'P'category)	Biomedical Electronics Engg		Basics of biomedical Engg			Biomedical Instrumentation Engg		Biomedical Imaging Engg		Health care Engg	
		X										
5	Approval	23rd meeting of Academic Council, May 2013										

BM1014	**FUNDAMENTALS OF SIGNALS AND SYSTEMS**	**L**	**T**	**P**	**C**
	Total contact Hours – 60	**3**	**1**	**0**	**4**
	Prerequisite				
	Nil				

PURPOSE

To familiarize with techniques suitable for analyzing and synthesizing both continuous-time and discrete time signals & systems.

INSTRUCTIONAL OBJECTIVES

1.	To study and analyze the continuous and discrete-time signals and systems, their properties and representations.
2.	To have Knowledge of time-domain representation and analysis concepts as they relate to difference equations, impulse response and convolution, etc.
3.	To familiarize the concepts of frequency-domain representation and analysis using Fourier Analysis tools, Z-transform.

4.	To understand the concepts of the sampling process and to identify and solve engineering problems
5.	To analyze the systems by examining their input and output signals

UNIT I - CLASSIFICATION OF SIGNALS AND SYSTEMS (12 Hours)

Representation of discrete time signals, Elementary discrete time signal, Basic operation on signals, classification of signals-Deterministic and random signal, periodic and Non-periodic, Energy and power signal, causal and Non-causal signal, Even and Odd signal. Classification of systems- static and dynamic system, casual and non-causal system, linear and non-linear system, time variant and time invariant system, stable and unstable system

UNIT II -ANALYSIS OF CONTINUOUS TIME SIGNALS (12 Hours)

Fourier series analysis-Trigonometric Fourier series, Cosine Fourier series, Exponential Fourier series, Fourier Spectrum of continuous time signals, Fourier transform analysis, Laplace transform, Analysis of electrical network using Laplace transform.

UNIT III - LTI – CONTINUOUS TIME SYSTEMS (12 Hours)

Analysis of differential equation-Transfer function-Impulse response-Frequency response-Convolution integral- Fourier Methods-Laplace transforms analysis-Block diagram representation-State variable equation and Matrix

UNIT IV - ANALYSIS OF DISCRETE TIME SIGNALS (12 Hours)

Spectrum of DT signals-Discrete Time Fourier Transform (DTFT)-Properties of discrete time Fourier transform-Discrete Fourier Transform (DFT)-Properties of DFT-Z-transform in signal analysis-Properties of Z- transform-Inverse Z-transform

UNIT V - LTI – DISCRETE TIME SYSTEMS (12 Hours)

Analysis of differential equation-Transfer function-Impulse response-Frequency response-Convolution SUM –Fast Fourier transform- Block diagram representation-State variable equation and Matrix.

TEXT BOOKS

1. A. Anand Kumar, "*Signals and Systems*" , PHI learning Pvt. Ltd., Second edition, 2012
2. Simon Haykin and Barry Van Veen, "*Signals and Systems*" , John Willey & Sons, Inc., Second edition, 2004

REFERENCES

1. Ashok Ambardar, "*Analog and Digital Signal Processing*", Thomson Learning Inc., Second Edition, 1999
2. Allan V. Oppenhein et al, "*Signals and Systems*", Prentice Hall of India Pvt. Ltd, Second edition, 1997

BM1014 FUNDAMENTALS OF SIGNALS AND SYSTEMS												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	J	K
			X			**X**						
2	Mapping of instructional objectives with student outcome		**1**			**1**						

3	Category	General (G)	Basic Sciences (B)	Engineering Sciences and Technical Arts (E)	Professional Subjects (P)
					X

4	Broad area (for 'P'category)	Biomedical Electronics Engg	Basics of biomedical Engg	Biomedical Instrumentation Engg	Biomedical Imaging Engg	Health care Engg
					X	
5	Approval	23rd meeting of Academic Council, May 2013				

BM1015	MEDICAL INSTRUMENTATION-I LAB	L	T	P	C
	Total contact Hours – 30	**0**	**0**	**2**	**1**
	Prerequisite				
	Nil				

PURPOSE

To study and analyze the theory and working of biomedical instruments

INSTRUCTIONAL OBJECTIVES

To get familiar with the various types of biomedical instruments and analyze the waveform pattern obtained from it.

LIST OF EXPERIMENTS

1. Real time acquisition of ECG, EEG & EMG and analysis
2. Analysis of abnormal ECG wave pattern using arrhythmia Simulator
3. Real time patient monitoring system
4. Pulse oximetry

5. Acquisition of Heart sounds using PCG
6. Biotelemetry system
7. BP measuring techniques
8. Glucose sensor
9. Differentiating Arteries and veins using Doppler ultrasonography
10. Heart Lung machine model – study
11. Pacemaker, Defibrillator Models – Study

The following National Instrument (NI)'s products will be used as a supplement:

1. NI ELVIS Hardware
2. Vernier Biomedical Sensor Kit
3. Quanser Myolectric Kit

REFERENCES

1. Medical Instrumentation Lab Manual

BM1015 MEDICAL INSTRUMENTATION-I LAB												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
			X									**X**
2	Mapping of instructional objectives with student outcome		**4**									**5**
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)		
										X		
4	Broad area (for 'P'category)	Biomedical Electronics Engg		Basics of biomedical Engg		Biomedical Instrumentation Engg			Biomedical Imaging Engg			Health care Engg
						X						
5	Approval	23rd meeting of Academic Council, May 2013										

BM1016	BIOMEDICAL CIRCUITS AND NETWORKS LAB	L	T	P	C
	Total contact Hours – 30	0	0	2	1
	Prerequisite				
	Nil				

PURPOSE

To gain the practical knowledge about the basic electrical circuits and the circuit theorems

INSTRUCTIONAL OBJECTIVES

1.	To verify the circuits using various circuit theorems
2.	To understand the transient analysis of AC circuits

LIST OF EXPERIMENTS

1. Verification of KVL and KCL
2. Verification of Superposition Theorem
3. Verification of Thevenin's Theorem
4. Verification of Norton's Theorem
5. Verification of Reciprocity Theorem
6. Verification of Compensation Theorem
7. Verification of Maximum Power Transfer Theorem
8. Series & Parallel Resonance Circuits
9. Transients in RLC circuits
10. Coupled Circuits & Tuned Circuits

The following National Instrument (NI)'s products will be used as a supplement:

1. NI ELVIS Circuit Prototyping Hardware
2. NI LabVIEW System Design Software
3. NI Multisim Circuit Simulation Software
4. NI Ultiboard PCB Design Software

REFERENCES

1. Circuits and Networks Lab Manual
2. David A. Bell, "*Fundamentals of Electric Circuits Lab Manual*", Oxford University Press, 7th Edition 2009

BM1016 BIOMEDICAL CIRCUITS AND NETWORKS LAB												
Course designed by		Department of Biomedical Engineering										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		X	**X**	**X**								
2	Mapping of instructional objectives with student outcome	**1,4**	**1**	**5**								
3	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)				Professional Subjects (P)	
											X	
4	Broad area (for 'P'category)	Biomedical Electronics Engg		Basics of biomedical Engg			Biomedical Instrumentation Engg			Biomedical Imaging Engg		Health care Engg
		X										
5	Approval	23rd meeting of Academic Council, May 2013										

BM1017	LINEAR INTEGRATED CIRCUITS LAB	L	T	P	C
	Total contact Hours - 30	**0**	**0**	**2**	**1**
	Prerequisite				
	Nil				

PURPOSE

To gain experience with the linear integrated circuits by designing and testing the various circuits being used in the biomedical instrumentation system.

INSTRUCTIONAL OBJECTIVES

1.	To understand the basic operational amplifier characteristics and its application
2.	To gain knowledge in designing of various amplifiers and multivibrators .
3.	To familiarize the operations of various types of converters and filter circuit design

LIST OF EXPERIMENTS

1. Study of DC characteristics of op-amp
2. Study of AC characteristics of op-amp
3. Basic Op-Amp applications-Summer, Differentiator and Integrator
4. Op-Applications-Inverting, Non-inverting and Buffer Amplifier
5. Design of an Instrumentation amplifier

6. Design of Half wave and full wave rectifier
7. Design of clipper and clamper
8. Design of comparator applications
9. Astable and monostable mutivibrator using IC 555.
10. Waveform generators-Sine wave: RCPSO, Wien Bridge; Triangular Wave
11. Design of active filters-LPF, HPF
12. Digital to analog converters-Weighted resistor DAC, R-2R Ladder DAC

The following National Instrument (NI)'s products will be used as a supplement:

1. NI ELVIS Circuit Prototyping Hardware
2. NI LabVIEW System Design Software
3. NI Multisim Circuit Simulation Software
4. NI Ultiboard PCB Design Software

REFERENCES

1. Linear Integrated Circuits Lab manual

BM 1017 LINEAR INTEGRATED CIRCUITS LAB												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
			X	**X**								
2	Mapping of instructional objectives with student outcome		**1**	**5**								
3	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
										X		
4	Broad area (for 'P'category)	Biomedical Electronics Engg			Basics of biomedical Engg		Biomedical Instrumentation Engg			Biomedical Imaging Engg		Health care Engg
		X										
5	Approval	23rd meeting of Academic Council, May 2013										

SEMESTER V

PD1005	**APTITUDE III**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	**1**	**0**	**1**	**1**
	Prerequisite				
	Nil				

PURPOSE
To enhance holistic development of students and improve their employability skills.

INSTRUCTIONAL OBJECTIVES	
1.	Understand the importance of effective communication in the workplace.
2.	Enhance presentation skills – Technical or general in nature.
3.	Improve employability scope through Mock GD, Interview

UNIT I **(6 Hours)**

Video Profile

UNIT II **(6 Hours)**

Tech Talk / Area of Interest / Extempore / Company Profile

UNIT III **(6 Hours)**

Curriculum Vitae

UNIT IV **(6 Hours)**

Mock Interview

UNIT V **(6 Hours)**

Group Discussion / Case Study

ASSESSMENT

1. Objective type – Paper based / Online – Time based test
2. 50% marks based on test, 50 % based on Continuous Communication assessment

REFERENCES

1. Bovee Courtland and Throill John, *Business Communication Essentials: A skills-Based Approach to Vital Business English*. Pearson Education Inc., 2011
2. Dhanavel, S.P., *English & Communication Skills for Students of Science and Engineering*. Orient Black Swan, 2009
3. Rizvi M. Ashraf *Effective Technical Communication*, Tata McGraw-Hill Publishing Company Limited, 2006.

PD1005 APTITUDE III												
Course designed by		Career Development Centre										
1	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
								X		X	X	
2	Mapping of instructional objectives with student outcome							1,2,3		1,2		2,3
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)		
		X										
4	Approval	23rd meeting of Academic Council, May 2013										

MA1035	MATHEMATICS FOR MEDICAL IMAGING	L	T	P	C
	Total contact Hours - 60 Hours	4	0	0	4
	Prerequisite				
	Nil				

PURPOSE

To develop an understanding of the methods of probability and statistics which are used to model engineering problems.

Instructional objectives:

1.	To gain knowledge in linear models of biological systems
2.	To learn about non linear equations in biomedical engineering
3.	To gain knowledge on probability concepts
4.	To learn the methods of studying correlation and regression.
5.	To learn about ANOVA

UNIT I LINEAR MODELS OF BIOLOGICAL SYSTEMS (12 Hours)

Introduction- Examples of linear biological systems- Simultaneous liner algebraic equations-solutions by Gauss Elimination and Gauss Jordan- Iterative approach for solution of linear systems- Gauss-Jacobi and Gauss seidal method

UNIT II NONLINEAR EQUATIONS IN BIOMEDICAL ENGINEERING (12 Hours)

Introduction- General form of non-liner equations – Examples – Bi section method – Method of direct iteration – Method of false position – Newton Raphson method

UNIT III PROBABILITY AND THEORETICAL DISTRIBUTIONS (12 Hours)

Probability concepts - conditional probability - Baye"s theorem - one - dimensional random variables - expectation, variance, moments. Theoretical distributions : Binomial, Poisson, Normal (Problems only).

UNIT IV CORRELATION AND REGRESSION ANALYSIS (12 Hours)

Methods of studying correlation – Karl pearson"s coefficient of correlation- Rank correlation method – Regression analysis – Regression lines – Regression equations – Regression coefficients

UNIT V ANALYSIS OF VARIANCE (12 Hours)

Small sample tests based on t and F distribution - Test for, single mean, difference between means, Paired t-test, test for equality of variances. ANOVA- one -way classification, Two-way classification.

TEXT BOOK

1. Stanley Dunn, Alkies Constantinides &Prabhas V. Moghe, "*Numerical methods in Bio medical engineering"*, Academic press,2006.
2. Gupta S.V & Kapoor V.K, "*Fundamentals of Mathematical Statistic"*s, Sultan Chand and Sons, 11th edition,New Delhi, 2007.

REFERENCES

1. Gupta S.C & Kapoor V.K, "*Fundamentals of Applied Statistics"*, Sultan Chand and Sons, New Delhi, 2003.
2. Ewans W & Grant G, "*Statistical Methods in Bio informatics - An Introduction"*, Springer, 2nd edition, 2005.

MA1035 MATHEMATICS FOR MEDICAL IMAGING												
Course designed by		**Department of Mathematics**										
1	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		X				X						
2	Mapping of instructional objectives with student outcome	1-5				1-5						
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)		
				X								
4	Approval	23rd meeting of academic council, May 2013										

BM1018	BIOMEDICAL SIGNAL PROCESSING	L	T	P	C
	Total contact Hours – 60	3	1	0	4
	Prerequisite				
	Basic knowledge of signals and systems				

PURPOSE

To learn the fundamental concepts of signal processing and to apply common signal processing techniques for various biomedical signals.

INSTRUCTIONAL OBJECTIVES

1.	To make them understand the fundamentals of signal processing for various bio-signal analysis
2.	To impart knowledge about filter characteristics and to design various filters
3.	To provide an in-depth knowledge about the basic concepts of wavelet and speech analysis
4.	To apply various signal processing techniques in analyzing the various bio-signal
5.	To study about the characteristics of non stationary signals

UNIT I - FUNDAMENTALS OF SIGNAL PROCESSING (12 Hours)

Sampling and aliasing , Signal reconstruction, Signal conversion systems, Circular convolution Correlation- Autocorrelation – Cross correlation, FFT -decimation in time algorithm, Decimation in Frequency algorithm

UNIT II - DIGITAL FILTER DESIGN (12 Hours)

Basics of filter, Design of IIR filter-impulse invariant method – Bilinear Transformation Method Warping and pre-warping effect, Frequency transformation, Characteristics of FIR filter, FIR filter design using windowing techniques- Rectangular window – Hamming window – Hanning window

UNIT III - WAVELET AND SPEECH PROCESSING (12 Hours)

Introduction to wavelets, Time frequency representation, Discrete wavelet transform, pyramid algorithm, Comparison of Fourier transform and wavelet transform, Speech analysis – Cepstrum – Homomorphic filtering of speech signals.

UNITIV - ANALYSIS OF BIOSIGNALS (12 Hours)

Automatic analysis and classification of ECG, P-wave detection, QRS complex detection, Correlation analysis of ECG signals, Signal averaged ECG, Analysis of Heart Rate variability, Synchronized averaging of PCG envelopes, envelogram, Analysis of PCG signal, Analysis of EMG signal

UNIT V - ADVANCED TOPICS IN BSP **(12 Hours)**

Analysis of non stationary signals- time variant system – Fixed segmentation-Short time Fourier transform, autocorrelation function method, Spectral error measure method, generalized likelihood ratio, Introduction to Adaptive filters, Adaptive segmentation .

TEXT BOOKS

1. John G. Proakis and Dimitris G.Manolakis, "*Digital Signal Processing*, *Algorithms and Applications"*, PHI of India Ltd., New Delhi, fourth Edition, 2007.
2. Rangaraj.M.Rangayyan, "*Biomedical signal processing"*, IEEE press, second edition*, 2015*

REFERENCES

1. Reddy D.C, "*Biomedical Signal Processing:Priniciples and Techniques",* Tata McGraw-Hill, New Delhi,2nd edition ,2005.
2. Sanjit K.Mitra "*Digital Signal Processing", A Computer Based Approach",* Tata McGraw-Hill, New Delhi, fourth edition 2011.
3. Nagoor kani A, '*Digital signal processing*', Tata McGraw-Hill, New Delhi, second edition 2012.

BM1018 BIOMEDICAL SIGNAL PROCESSING												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	K
		X	**X**			**X**						
2	Mapping of instructional objectives with student outcome	**1**	**2**			**4**						
3	Category	General (G)	Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)			
									X			
4	Broad area (for "P"category)	Biomedical Electronics Engg		Basics of biomedical Engg		Biomedical Instrumentation Engg			Biomedical Imaging Engg	Health care Engg		
									X			
5	Approval	23rd meeting of Academic Council, May 2013										

BM1019	MEDICAL INSTRUMENTATION-II	L	T	P	C
	Total contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	The student should have studied Medical Instrumentation-I				

PURPOSE

To acquire an adequate knowledge about measurement of various physiological parameters and to understand the fundamental principle and working of the biomedical instruments involved in the measurement.

INSTRUCTIONAL OBJECTIVES

1.	To learn about pulmonary analyzers and aid equipments and their functions on respiratory system
2.	To provide clear knowledge about physiotherapy and electrotherapy equipments
3.	To gain knowledge about instruments dealing with kidney and bones
4.	To provide clear knowledge about the instruments used for sensory measurements and able to design sensors
5.	To provide latest knowledge of special medical assistive and therapeutic equipments and learn how to use that equipments and servicing

UNIT I - PULMONARY ANALYZERS AND AID EQUIPMENTS (9 Hours)

Regulation of Breathing - Pulmonary gas flow measurements - Pulmonary volume measurements - Respiratory gas analyzers – Nitrogen Gas Analyzer, Oxygen Analyzer - Humidifier, Nebulizer – Ventilators - IPPB Unit - Anasthesia machine

UNIT II - PHYSIOTHERAPY AND ELECTROTHERAPY EQUIPMENTS (10 Hours)

Tissue response -Short ware diathermy - Microwave diathermy - Ultrasonic therapy Unit - Eletrotherapy - FES, TENS - Bladder stimulator - Lithotripter system - Extra corporeal Shock wave therapy

UNIT III - INSTRUMENTS DEALING WITH KIDNEY AND BONES (9 Hours)

Regulation of Water and Electrolyte Balance – Artificial Kidney – Hemo dialysis - Crafts for dialysis - Peritoneal dialysis - Dialyzers – different types - BMD Measurements – SXA – DXA - Quantitative ultrasound bone densitometer

UNIT IV - SENSORY INSTRUMENTATION (10 Hours)

Mechanism of Hearing, Sound Conduction System - Basic Audiometer, Pure toneaudiometer, Audiometer system Bekesy – Hearing Aids - Ophthalmoscope – Tonometer - Measurement of Basal Skin response and Galvanic skin response -

Instruments for testing Motor responses - Experimental Analysis of Behavior - Biofeedback Instrumentation

UNIT V - SPECIAL EQUIPMENTS (7 Hours)

Endoscopy – Laparoscopy - Cryogenic Equipment - Automated drug delivery system – Components of drug infusion system – Implantable infusion systems.

TEXT BOOKS

1. Geoddes L.A and Baker L.E, "*Principles of Applied Biomedical Instrumentation",* John Wiley, 3rd Edition, 1975, Reprint 1989.
2. Khandpur R.S, *"Hand-book of Biomedical Instrumentation",* Tata McGraw Hill, 2nd Edition, 2003.
3. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, *"Biomedical Instrumentation and Measurement"*, Prentice-Hall India, 2nd Edition,1997

REFERENCES

1. Stuart MacKay R, "*Bio-Medical Telemetry: Sensing and Transmitting Biological Information from Animals and Man",* Wiley-IEEE Press, 2nd Edition, 1968.
2. John G. Webster, "Medical *Instrumentation application and design*", JohnWiley, 3rd Edition, 1997.
3. Carr, Joseph J, Brown, John M., *"Introduction to Biomedical equipment technology",* John Wiley and sons, New York, 4th Edition, 1997.
4. Rajarao C and Guha S.K, *"Principles of Medical Electronics and Bio-medical Instrumentation",* Universities press (India) Ltd, First Edition, Orient Longman ltd, 2001.

BM1019 MEDICAL INSTRUMENTATION -II												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
			X									**X**
2	Mapping of instructional objectives with student outcome		**4**									**5**
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)		
										X		

4	Broad area (for "P"category)	Biomedical Electronics Engg	Basics of biomedical Engg	Biomedical Instrumentation Engg	Biomedical Imaging Engg	Health care Engg
				X		
5	Approval	23rd meeting of Academic Council, May 2013				

BM1020	**MEDICAL IMAGING SYSTEMS**	**L**	**T**	**P**	**C**
	Total contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

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

INSTRUCTIONAL OBJECTIVES

1.	To learn the different methods and modalities used for medical imaging
2.	To learn the preferred medical imaging methods for routine clinical applications
3.	To understand the engineering models used to describe and analyze medical images
4.	To apply these tools to different problems in medical imaging
5.	To practice methods used to analyze medical images

UNIT I - X-RAY (9 Hours)

Principles and production of soft X-rays and hard X-rays- Details of radiographic and fluoroscopic images in X-Ray systems- Screen-film and image intensifier systems, computed radiography, digital radiography, flat panel detectors, mammography, Transverse tomography, CT Angiography

UNIT II - PET AND SPECT IMAGING (9 Hours)

Introduction to emission tomography, basic physics of radioisotope imaging Compton cameras for nuclear imaging, PET scanner principles, SPECT, Computer techniques in fast acquisition Analytic image reconstruction techniques.

UNIT III - MAGNETIC RESONANCE IMAGING (MRI) (9 Hours)

Image acquisition in magnetic resonance imaging MRI-T1 MRI-T2 proton density weighted images spin-echo technique and spin relaxation technique- MRI artifacts- Various types of pulse sequences for fast acquisition of imaging, NMR spectroscopy

UNIT IV - ULTRASOUND (US) IMAGING (9 Hours)

Physics of ultrasound- Principles of image formation, capture and display- Principles

of A-Mode, B-Mode, M-Mode- Scan converters- Doppler ultrasound- pulsed and continuous, US artifacts

UNIT V - OTHER IMAGING TECHNIQUES (9 Hours)

Infrared (IR) imaging: Thermography- Clinical applications of thermography, liquid crystal thermography. Optical coherence tomography (OCT): Introduction and its medical applications- Advances in image resolutions and speed in picture archiving and communication systems (PACS) in medical imaging.

TEXT BOOKS

1. Khandpur R.S, *"Hand-book of Biomedical Instrumentation",* Tata McGraw Hill, 2nd Edition, 2003.
2. William R. hendee, E, Russell Ritenour "*Medical imaging physics"*, Fourth edition, 2002

REFERENCES

1. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, *"Biomedical Instrumentation and Measurements"*, Prentice-Hall of India, 2nd Edition, 1997.
2. Wolfgang Drexler James G.Fijimoto "*Optical coherence tomography technology and applications"*, Springer, First edition, 2008

BM1020 MEDICAL IMAGING SYSTEMS													
Course designed by		**Department of Biomedical Engineering**											
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k	
									X			**X**	
2	Mapping of instructional objectives with student outcome								**2**			**4**	
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)					Professional Subjects (P)		
											x		
4	Broad area (for "P"category)	Biomedical Electronics Engg		Basics of biomedical Engg		Biomedical Instrumentation Engg			Biomedical Imaging Engg		Health care Engg		
									X				
5	Approval	23rd meeting of Academic Council, May 2013											

	BIOMEDICAL SIGNAL PROCESSING LAB	L	T	P	C
BM1021	Total contact Hours - 30	0	0	2	1
	Prerequisite				
	Nil				

PURPOSE

To gain the practical knowledge about the various bio signals and its characteristics

INSTRUCTIONAL OBJECTIVES

1.	To represent the basic discrete time signals and analyze it
2.	To design the IIR and FIR filter
3.	To analyze various types of bio signals and study its characteristics

LIST OF EXPERIMENTS

1. Representation of basic discrete time signals
2. Computation of convolution –linear convolution
3. Response of a difference equation to initial conditions; stability
4. DFT and FFT computation
5. FIR filter design using windowing techniques
6. IIR filters design-digital Butterworth filter and Chebyshev filter
7. Simulation of Bio-signals.
8. Analysis of ECG signals.
9. Analysis of EEG signals
10. Analysis of EMG signals

The following National Instrument (NI)"s products will be used as a supplement:

1. NI Vision Development Module
2. NI Vision Acquisition Software
3. Vision Builder for Automated Inspection tools

REFERENCE

1. Biomedical Signal Processing Lab Manual

BM1021 BIOMEDICAL SIGNAL PROCESSING LAB												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		X	**X**			**X**						
2	Mapping of instructional objectives with student outcome	**1**	**2**			**4**						
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)		Professional Subjects (P)				
								X				
4	Broad area (for "P"category)	Biomedical Electronics Engg		Basics of biomedical Engg		Biomedical Instrumentation Engineering		Biomedical Imaging Engg		Health care Engg		
								X				
5	Approval	23rd meeting of Academic Council, May 2013										

BM1022	**MEDICAL INSTRUMENTATION-II LAB**	**L**	**T**	**P**	**C**
	Total contact Hours - 30	**0**	**0**	**2**	**1**
	Prerequisite				
	Nil				

PURPOSE

To study and analyze the theory and working of biomedical instruments

INSTRUCTIONAL OBJECTIVES

To get familiar with the various types of biomedical diagnostic and therapeutic instruments and understand the functioning of them.

LIST OF EXPERIMENTS:

1. Respiratory system testing using Spirometer
2. Short wave Diathermy- study
3. Ultrasound Diathermy- study
4. Surgical Diathermy - study
5. Hemodialysis model –study
6. Audiometer
7. Measurement of Galvanic skin resistance
8. Conduction velocity measurement
9. Respiration rate measurement
10. BMD Measurement

REFERENCES

1. Medical Instrumentation Lab Manual

BM1022 MEDICAL INSTRUMENTATION –II LAB												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
			X									**X**
2	Mapping of instructional objectives with student outcome		**4**									**5**
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)		
										X		
4	Broad area (for "P"category)	Biomedical Electronics Engg		Basics of biomedical Engg		Biomedical Instrumentation Engg		Biomedical Imaging Engg		Health care Engg		
						X						
5	Approval	23rd meeting of Academic Council, May 2013										

	INDUSTRIAL TRAINING I **Training to be undergone after IV Semester**	**L**	**T**	**P**	**C**
BM1047	2 week practical training in industry	**0**	**0**	**1**	**1**
	Prerequisite				
	Nil				

PURPOSE

To provide hands-on experience at site where biomedical equipments are manufactured and utilized (Hospitals)

INSTRUCTIONAL OBJECTIVES

1.	To enable the students to gather a first hand experience on usage of various biomedical equipments.
2.	To be familiar with various medical imaging techniques.
3.	To gain some practical experience in servicing the equipments.

Students have to undergo two weeks practical training in biomedical equipments manufacturing companies or hospitals but with approval of the department. At the end of the training student will submit a report as per the prescribed format to the department.

ASSESSMENT PROCESS

This course is mandatory and the student has to pass the course to become eligible for award of the degree. The student shall make a presentation before a committee constituted by the department which will assess the student based on the report submitted and the presentation made.Marks will be awarded out of 100 and appropriate grades assigned as per the regulations.

<table>
<tr><td colspan="13">BM1047 INDUSTRIAL TRAINING I</td></tr>
<tr><td colspan="2">Course designed by</td><td colspan="11">Department of Biomedical Engineering</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Student outcome</td><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td>g</td><td>h</td><td>i</td><td>j</td><td>k</td></tr>
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<tr><td>2</td><td>Mapping of instructional objectives with student outcome</td><td>1</td><td></td><td></td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td></td><td></td></tr>
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<tr><td rowspan="2">4</td><td rowspan="2">Broad area (for “P”category)</td><td colspan="2">Biomedical Electronics Engg</td><td colspan="2">Basics of biomedical Engg</td><td colspan="3">Biomedical Instrumentation Engg</td><td colspan="2">Biomedical Imaging Engg</td><td colspan="2">Health care Engg</td></tr>
<tr><td colspan="2">X</td><td colspan="2">X</td><td colspan="3">X</td><td colspan="2">X</td><td colspan="2">X</td></tr>
<tr><td>5</td><td>Approval</td><td colspan="11">23rd meeting of Academic Council, May 2013</td></tr>
</table>

SEMESTER VI

PD1006	APTITUDE IV	L	T	P	C
	Total Contact Hours - 30	1	0	1	1
	Prerequisite				
	Nil				

PURPOSE	
To enhance holistic development of students and improve their employability skills.	
INSTRUCTIONAL OBJECTIVES	
1.	To improve aptitude, problem solving skills and reasoning ability of the student.
2.	To collectively solve problems in teams & group.

UNIT I - ARITHMETIC - II **(6 Hours)**

Ratios & Proportions, Averages, Mixtures & Solutions

UNIT II - ARITHMETIC – III **(6 Hours)**

Time, Speed & Distance, Time & Work

UNIT III - ALGEBRA – II **(6 Hours)**

Quadratic Equations, Linear equations & inequalities

UNIT IV– GEOMETRY **(6 Hours)**

2D Geometry, Trigonometry, Mensuration

UNIT V – MODERN MATHEMATICS – II **(6 Hours)**

Sets & Functions, Sequences & Series, Data Interpretation, Data Sufficiency

ASSESSMENT

1. Objective type – Paper based / Online – Time based test

REFERENCES

1. Agarwal.R.S – *"Quantitative Aptitude for Competitive Examinations",* S Chand Limited 2011
2. Abhijit Guha*, "Quantitative Aptitude for Competitive Examinations",* Tata Mcgraw Hill, 3rd Edition
3. Edgar Thrope*, "Test Of Reasoning For Competitive Examinations",* Tata Mcgraw Hill, 4th Edition
4. Other material related to quantitative aptitude

PD1006 APTITUDE IV												
Course designed by		Career Development Centre										
1	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		X			X							
2	Mapping of instructional objectives with student outcome	1			1							
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)		
		X										
4	Approval	23rd meeting of Academic Council, May 2013										

BM1023	MEDICAL IMAGE PROCESSING AND ANALYSIS	L	T	P	C
	Total contact Hours - 60	3	1	0	4
	Prerequisite				
	Basic knowledge of matrices and Fourier transform				

PURPOSE

To learn the fundamental concepts of medical image acquisition and understand how to apply the image processing techniques for various medical images.

INSTRUCTIONAL OBJECTIVES

1.	To learn the image fundamentals and mathematical transforms necessary for image processing
2.	To study the various image enhancement techniques
3.	To apply various image restoration procedures in Medical images.
4.	To gain knowledge about the basic concepts of image compression procedures.
5.	To study about the various segmentation techniques applied to Medical Images.

UNIT I - FUNDAMENTALS OF DIGITAL IMAGE AND TRANSFORMS (12 Hours)

Elements of Visual perception, Image sampling and quantization, Neighborhood pixel Relationships – Basic Image operations – Arithmetic, Geometric and Morphological, Image transform: 2D DFT- Discrete cosine-, Sine-, Haar-, and Hadamard- transform

UNIT II - IMAGE ENHANCEMENT (12 Hours)

Basic gray level transformation, Histogram processing ,Smoothening by spatial filters - Sharpening by spatial filters ,Smoothening- frequency domain filters, Sharpening-frequency domain filters ,Color image Processing- color models- Pseudo color image processing– Color Image Transformation.

UNIT III - IMAGE SEGMENTATION (**12 Hours)**

Edge detection- Marr Hidreth edge detector - Canny edge detector, Thresholding-foundation - Basic global thresholding - Basic Adaptive thresholding, Region Based segmentation, Watershed segmentation algorithm.

UNIT IV - IMAGE COMPRESSION **(12 Hours)**

Image compression- Fundamentals - Image compression standards- Coding: Run length-, Huffman- Arithmetic-, Bit plane-, Transform- and Lossy- and lossless-predictive coding

UNIT V - IMAGE RESTORATION AND RECONSTRUCTION OF MEDICAL IMAGES **(12 Hours)**

Image degradation models, Algebraic approach to restoration, inverse filtering, Least mean square filter, Image reconstruction from projections - Radon transforms - Filter back projection algorithm – Fourier reconstruction of MRI Images

TEXT BOOKS

1. Rafael C., Gonzalez and Richard E. Woods, "*Digital Image Processing*", Pearson Education Asia, Third Edition, 2007
2. Anil K. Jain, "*Fundamentals of Digital Image Processing*", Prentice Hall of India,2nd edition 1997.

REFERENCES

1. William K. Pratt, "*Digital Image Processing*", John Wiley, NJ, 4th Edition, 2007
2. Albert Macouski, "*Medical Imaging systems*", Prentice Hall, New Jersey 2nd edition 1997

BM1023 MEDICAL IMAGE PROCESSING AND ANALYSIS												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		X	**X**		**X**							
2	Mapping of instructional objectives with student outcome	**1**	**2**		**5**							
3	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
										X		
	Broad area (for	Biomedical		Basics of			Biomedical		Biomedic		Health	

4	P"category)	Electronics Engg	biomedical Engg	Instrumentation Engg	al Imaging Engg	care Engg
					X	
5	Approval	23rd meeting of Academic Council, May 2013				

BM1024	**MICROPROCESSOR AND MICROCONTROLLER BASED BIOMEDICAL INSTRUMENTATION**	**L**	**T**	**P**	**C**
	Total contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

To understand the functioning of different microprocessors and microcontrollers and to use microprocessor for various applications in biomedical instrumentation.

INSTRUCTIONAL OBJECTIVES

1.	To study the concept of basic microprocessor 8085
2.	To study the concept of microprocessor 8086
3.	To get knowledge about various interfacing devices
4.	To interface device with the processors
5.	To study the concept of microcontroller

UNIT I - MICROPROCESSOR-8085 (8 Hours)

Evolution & Importance of microprocessor, Microprocessor-8085: Introduction, feature, architecture, pin diagram, addressing mode, instruction set, timing diagram, interrupt- Programming exercise

UNIT II - MICROPROCESSOR-8086 (9 Hours)

Microprocessor-8086: Introduction, comparison with microprocessor-8085, feature, architecture, pin diagram, addressing mode, instruction set, minimum- and maximum-mode, assembler directives and operators, interrupts- Programming exercise

UNIT III - PERIPHERAL DEVICES (12 Hours)

Interfacing: Memory- and I/O- interfacing- Programmable Peripheral Interface (PPI)-8255: Pin diagram, block diagram, and operating modes- Programmable Communication Interface (PCI)-8251 USART: Pin diagram, block diagram, and command word- Programmable Interrupt Controller (PIC)-8259A: Pin diagram, block

diagram, interrupt sequence, and cascading- Keyboard/Display Controller-8279: Pin diagram, block diagram, operating modes.

UNIT IV - MICROCONTROLLER-8051 (9 Hours)

Introduction to 8 bit microcontroller, bus configuration, architecture of 8031/8051, Signal descriptions of 8051, Register set of 8051, Memory- and I/O Interfacing: Interrupts, instruction set, and addressing mode- Simple programs

UNIT V - APPLICATIONS IN MEDICINE (7 Hours)

Mobile phone based bio signal recording, microprocessor based vision architecture for integrated diagnostic helping devices, Microprocessor based remote health monitoring system: Concept and systems, and system operation.

TEXT BOOKS

1. Ramesh S.Gaonkar "*Microprocessor architecture, programming and its application with 8085"*, Penram Int. Pub. (India), Fifth edition, 2002.
2. Roy A.K, Bhurchandi K.M," "*Intel Microprocessors Architecture, Programming and Interfacing"*, McGraw Hill International Second Edition, 2006.

REFERENCES

1. Muhammad Ali Mazidi and Janica Gilli Mazidi, "*The 8051 microcontroller and embedded systems*", Pearson Education, Fifth edition, 2003.
2. Rafiquzzaman M. "*Microprocessors - Theory and Applications"* Intel and Motorola, Prentice Hall of India Pvt. Ltd, Second edition, 2001.
3. Douglas V.Hall "*Microprocessors and Interfacing programming and hardware"*, Tata McGraw Hill, Fourth Edition, 2003.
4. Nagoor kani A, *" Microprocessors and Microcontrollers"* Tata McGraw Hill, second Edition, 2012.

BM1024 MICROPROCESSOR AND MICROCONTROLLER BASED BIOMEDICAL INSTRUMENTATION												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		X	**X**						**X**			**X**
2	Mapping of instructional objectives with student outcome	**1**	**2**						**3**			**5**
3	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
										x		

4	Broad area (for "P"category)	Biomedical Electronics Engg	Basics of biomedical Engg	Biomedical Instrumentation Engg	Biomedical Imaging Engg	Health care Engg
				X		
5	Approval	23rd meeting of Academic Council, May 2013				

		L	T	P	C
BM1029	**REHABILITATION ENGINEERING**				
	Total contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Basic knowledge of human anatomy and physiology				

PURPOSE

To learn the basic concepts of rehabilitation engineering and assist devices and to understand the importance of biomedical engineering in rehabilitation.

INSTRUCTIONAL OBJECTIVES

1.	To study basics of Rehabilitation Engineering
2.	To learn the design of Wheel Chairs
3.	To study various orthotic & prosthetic devices
4.	To understand various assistive technology for vision & hearing
5.	To gain knowledge of the recent developments in the field of rehabilitation engineering.

UNIT I - INTRODUCTION TO REHABILITATION ENGINEERING (9 Hours)

Introduction to Rehabilitation Engineering - PHAATE model - Clinical practice of rehabilitation Engineering - Low technology tools - Service delivery - Universal design - Design based on human ability - Standards for assistive technology - Test for best design

UNIT II - WHEEL CHAIR (9 Hours)

Seating Assessment - Interventions in seating system - Biological aspects of tissue health - Support surface classification - Manual wheelchairs - Electric power wheelchairs - Power assisted wheelchairs - Wheel chair standards & tests - Wheel chair transportation

UNIT III - ORTHOTIC & PROSTHETIC DEVICES (9 Hours)

Anatomy of upper & lower extremities - Classification of amputation types, Prosthesis prescription - Components of upper limb prosthesis - Fabrication of prosthesis -

Components of lower limb prosthesis – Orthoses: It"s need and types - Lower extremity- and upper extremity- orthoses - Slints – materials used

UNIT IV - ASSISTIVE TECHNOLOGY FOR VISION & HEARING (9 Hours)

Anatomy of eye, Categories of visual impairment - Cortical & retinal implants - Auditory Information Display - Blind mobility aids – reading writing & graphics access, Orientation & navigation Aids - Anatomy of ear – hearing functional assessment - Surgical and non surgical hearing aids - Assistive technology solutions for hearing Tactile - Information Display

UNIT V - ADVANCED APPLICATIONS (9 Hours)

Functional Electrical stimulation - Robots in rehabilitation - Rehabilitation in sports - Daily living aids - Assistive technology for dyslexia - Computer & internet access for challenged people - Neural engineering in rehabilitation engineering - Role of biomedical engineering in rehabilitation

TEXT BOOKS

1. Rory A Cooper, Hisaichi Ohnabe, Douglas A Hodson, *"An Introduction to Rehabilitation Engineering",* CRC Press, First edition, 2006

REFERENCES

1. Marion A Hersh, Michael A Johnson, "*Assistive Technology for Visually impaired and blind people"*, Springer Publications, First edition, 2008
2. Suzanne Robitaille, "*The illustrated guide to Assistive technology and devices–Tools and gadgets for living independently"*, Demos Health Newyork, First edition, 2010

BM1029 REHABILITATION ENGINEERING												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		X		**X**	**X**		**X**		**X**	**X**		
2	Mapping of instructional objectives with student outcome	**2**		**1**	**4**		**5**		**3**	**3**		
3	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)	
											X	
4	Broad area (for	Biomedical			Basics of		Biomedical		Biomedical		Health	

	"P"category)	Electronics Engg	biomedical Engg	Instrument ation Engg	Imaging Engg	care Engg
						X
5	Approval	23rd meeting of Academic Council, May 2013				

BM1025	**MEDICAL IMAGE PROCESSING AND ANALYSIS LAB**	**L**	**T**	**P**	**C**
	Total contact Hours - 30	**0**	**0**	**2**	**1**
	Prerequisite				
	Nil				

PURPOSE

To gain the practical knowledge about the processing of medical images

INSTRUCTIONAL OBJECTIVES

1.	To understand the fundamentals of digital image and its properties
2.	To enhance the medical images by applying various filters
3.	To segment the region of interest using various image processing algorithms

LIST OF EXPERIMENTS

1. Digital image Fundamentals.
2. Image Enhancement
3. Removal of noise in medical images.
4. Image Transformation in spatial domain and frequency domain.
5. Edge detection and boundary tracing techniques.
6. Region based processing
7. Color image processing
8. Statistical Image Analysis.
9. Image compressions.
10. Image segmentation by thresholding

REFERENCES

1. Medical Image Processing and Analysis Lab Manual

BM1025 MEDICAL IMAGE PROCESSING AND ANALYSIS LAB												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		X	**X**		**X**							
2	Mapping of instructional objectives with student outcome	**1**	**2**		**5**							

3	Category	General (G)	Basic Sciences (B)	Engineering Sciences and Technical Arts (E)		Professional Subjects (P)
						X
4	Broad area (for "P"category)	Biomedical Electronics Engg	Basics of biomedical Engg	Biomedical Instrumentation Engg	Biomedical Imaging Engg	Health care Engg
					X	
5	Approval	23rd meeting of Academic Council, May 2013				

BM1026	MICROPROCESSOR AND MICROCONTROLLER BASED BIOMEDICAL INSTRUMENTATION LAB	L	T	P	C
	Total contact Hours - 30	0	0	2	1
	Prerequisite				
	Nil				

PURPOSE

To study and understand the functioning of different microprocessors and microcontrollers. To use microprocessor for various applications.

INSTRUCTIONAL OBJECTIVES

1.	To study the concept of basic microprocessors 8085, and 8086
2.	To interface device with the processors to meet real time applications.

LIST OF EXPERIMENTS

1. Addition and subtraction of 8 bit numbers
2. Addition and subtraction of 16 bit numbers
3. Multi byte subtraction
4. Multiplication of two 8 bit numbers
5. Division of two 8 bit numbers
6. Sorting numbers in ascending order and descending order
7. Block data transfer - forward and reverse order
8. Sum of series of N numbers
9. Code conversion Decimal to Hexadecimal and Hexadecimal to Decimal
10. Stepper motor control
11. Interfacing of Analog to digital (ADC)
12. Interfacing of Digital to Analog converter (DAC)
13. Interfacing of traffic light control systems
14. Keyboard/ Display Interface
15. Rolling display
16. Flashing display
17. Checking various clocks and timers of microcontroller

18. Reduce code size by using different commands

REFERENCES

1. Microprocessor Based Biomedical Instrumentation Lab Manual

BM1026 MICROPROCESSOR AND MICROCONTROLLER BASED BIOMEDICAL INSTRUMENTATION LAB												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		X	**X**						**X**			**X**
2	Mapping of instructional objectives with student outcome	**1**	**2**						**3**			**5**
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)			
									x			
4	Broad area (for "P"category)	Biomedical Electronics Engg		Basics of biomedical Engg		Biomedical Instrumentation Engg		Biomedical Imaging Engg		Health care Engg		
						X						
5	Approval	23rd meeting of Academic Council, May 2013										

BM1049	**MINOR PROJECT**	**L**	**T**	**P**	**C**
	Prerequisite	**0**	**0**	**2**	**1**
	Nil				

PURPOSE

To simulate real life situations related to Biomedical Engineering and impact adequate training so that confidence to face and tackle any problem in the field is developed in the college itself.

INSTRUCTIONAL OBJECTIVES

1.	To guide the students such a way that the students carry out a comprehensive work on the chosen topic which will stand them in good stead as they face real life situation.

PROJECT

Hardware/ Numerical/Theoretical research and development work is to be allotted. A maximum number of six students may be involved in each project. However the

contribution of the individuals in the project should be clearly brought out. The combined project report is to be submitted as per the university regulations. A seminar has to be presented on the allotted topic. All the students involved in the project will be examined for their contribution.

<table>
<tr><td colspan="13">BM1049 MINOR PROJECT</td></tr>
<tr><td colspan="2">Course designed by</td><td colspan="11">Department of Biomedical Engineering</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Student outcome</td><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td>g</td><td>h</td><td>i</td><td>j</td><td>k</td></tr>
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<tr><td rowspan="2">3</td><td rowspan="2">Category</td><td colspan="2">General (G)</td><td colspan="3">Basic Sciences (B)</td><td colspan="3">Engineering Sciences and Technical Arts (E)</td><td colspan="3">Professional Subjects (P)</td></tr>
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<tr><td rowspan="2">4</td><td rowspan="2">Broad area (for “P”category)</td><td colspan="2">Biomedical Electronics Engg</td><td colspan="2">Basics of biomedical Engg</td><td colspan="3">Biomedical Instrumentation Engg</td><td colspan="3">Biomedical Imaging Engg</td><td colspan="2">Health care Engg</td></tr>
<tr><td colspan="2">X</td><td colspan="2">X</td><td colspan="3">X</td><td colspan="3">X</td><td colspan="2">X</td></tr>
<tr><td>5</td><td>Approval</td><td colspan="11">23rd meeting of Academic Council, May 2013</td></tr>
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SEMESTER VII

BM1027	**BIOMEDICAL CONTROL SYSTEMS**	**L**	**T**	**P**	**C**
	Total contact Hours - 60	**3**	**1**	**0**	**4**
	Prerequisite				
	Nil				

PURPOSE	
To gain basic knowledge about the concepts of control systems and study its application in physiological modeling.	
INSTRUCTIONAL OBJECTIVES	
1.	To understand the system concepts and different mathematical modeling techniques applied in analyzing any given system.
2.	To analyze the given system in time domain and frequency domain.
3.	To study the techniques of plotting the responses in both domain analyses using various plots.
4.	To learn the concepts of physiological modeling systems
5.	To apply these analysis to understand the biological systems

UNIT I - CONTROL SYSTEM MODELLING (8 Hours)

System concept, Differential Equations, Transfer functions, Modeling of electrical systems Translational systems, Rotational mechanical systems, Electro-mechanical systems, physiological systems, Modeling block diagram, reduction methods, Signal flow graphs

UNIT II - TIME RESPONSE ANALYSIS (9 Hours)

Time domain specifications, step and impulse response analysis of first order and second order systems, steady state errors, stability, Routh-Hurwitz criteria, Root locus techniques, Construction of root locus stability, Dominant poles applications of Root locus diagram

UNIT III - FREQUENCY RESPONSE ANALYSIS (10 Hours)

Frequency response Bode plot, Nyquist plot, Nyquist stability criterion, Relative stability, Gain margin, phase margin, bandwidth magnitude plots, Polar plot, Nichol"s chart.

UNIT IV - PHYSIOLOGICAL CONTROL SYSTEM (8 Hours)

Introduction to physiological control systems, Human Thermal system, Neuro muscular system

occulomotor system, Respiratory system, difference between engineering and physiological control systems, generalized system properties.

UNIT V - MODELLING OF PHYSIOLOGICAL SYSTEMS (10 Hours)

Parameter estimation, linearizing, Block diagram representation of the muscle stretch reflex, Linear model of respiratory mechanics, model of chemical regulation of ventilation ,linear model of muscle mechanics, model of regulation of cardiac output.

TEXT BOOK

1. Nagrath J and Gopal M, "*Control System Engineering",* New Age international Publishers, 5th Edition, 2007.
2. Gopal M, "*Control System – Principles and Design*", Tata McGraw Hill, 2nd Edition, 2002.

REFERENCES

1. Michael C K Khoo "*Physiological control systems*" IEEE press, John Wiley & Sons Inc., First edition, 2000

<table>
<tr><th colspan="13">BM1027 BIOMEDICAL CONTROL SYSTEMS</th></tr>
<tr><td colspan="2">Course designed by</td><td colspan="11">Department of Biomedical Engineering</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Student outcome</td><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td>g</td><td>h</td><td>i</td><td>j</td><td>k</td></tr>
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<tr><td>5</td><td>Approval</td><td colspan="11">23rd meeting of Academic Council, May 2013</td></tr>
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BM1028	**VIRTUAL INSTRUMENTATION DESIGN FOR MEDICAL SYSTEMS**	**L**	**T**	**P**	**C**
	Total contact Hours – 45	**3**	**1**	**0**	**4**
	Prerequisite				
	Nil				

PURPOSE:	
To impart adequate knowledge on Virtual Instrumentation for acquisition and analysis of signals in medical system	
INSTRUCTIONAL OBJECTIVES	
1.	To educate about the Basic concepts of VI
2.	To make them understand the programming concepts of VI.
3	To provide an insight to various Common Instrument Interface.
4	To enable them to implement VI in medical systems
5.	To impart knowledge on various analysis tools

UNIT I - INTRODUCTION TO VIRTUAL INSTRUMENTATION (VI) (8 Hours)

Virtual instrumentation (VI): Evolution, Definition, Architecture- Conventional-, and, Comparison of VI with traditional Instruments, Need of VI, advantages, block diagram, data flow techniques, graphical programming, Comparison between graphical programming and conventional programming.

UNIT II - PROGRAMMING MODES IN VI (10 Hours)

VI: front panel, Block diagram, LABVIEW Environment: Startup-, Shortcut-, and Pull down menu, Palletes, Control structures: FOR loop, WHILE loop, Shift Registers, feedback nodes, Selection Structures: Case and sequence structures, Formulae nodes, Arrays, Clusters, Waveform Chart and graph, XY Graph, Strings, Tables, File I/O functions.

UNIT III - HARDWARE ASPECTS OF VI SYSTEM (9 Hours)

Digital I/O Techniques: pull-up and pull down resistors, TTL to solid state Relays, Voltage dividers, data acquisition in LABVIEW, hardware installation and configuration, Data acquisition (DAQ): Components, Accessories, Hardware, and Software**.**

UNIT IV - COMMON INSTRUMENT INTERFACE (10 Hours)

Current loop:4-20mA,60mA, RS232, RS422, RS485, General purpose interface bus(GIPB) ,Virtual Instrument Software Architecture (VISA), Universal serial port bus(USB), Peripheral computer interface (PCI), VME extensions for instrumentation (VXI), PCI extensions for Instrumentation (PXI), Personal Computer Memory Card

International Association (PCMCIA), Signal conditioning extension for instrumentation (SCXI).

UNIT V - ANALYSIS TOOLS AND APPLICATIONS OF VI (8 Hours)

Fourier transform, Power spectrum, Correlation, Windowing, filtering, Oscilloscope, Waveform generator, Multi-channel data acquisition using LABVIEW, Biomedical applications.

TEXT BOOKS

1. Gary Jonson, "*Labview Graphical Programming*", Second Edition, McGraw Hill, New York, Fourth edition 2006.
2. Lisa K. wells & Jeffrey Travis, "*Labview for everyone*", Prentice Hall Inc., New Jersey;First edition 1997.

REFERENCES

1. Gupta S, Gupta J P, *"PC interfacing for Data Acquisition & Process Control"*, Instrument Society of America, Second Edition, 1994
2. Technical Manuals for DAS Modules of Advantech and National Instruments

BM1028 VIRTUAL INSTRUMENTATION DESIGN FOR MEDICAL SYSTEMS													
Course designed by		**Department of Biomedical Engineering**											
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k	
				X		**X**						**X**	
2	Mapping of instructional objectives with student outcome			**2**		**5**						**2**	
3	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)				Professional Subjects (P)		
											X		
4	Broad area (for "P"category)	Biomedical Electronics Engg		Basics of biomedical Engg			Biomedical Instrumentation Engineering			Biomedical Imaging Engg		Health care Engg	
							X						
5	Approval	23rd meeting of Academic Council, May 2013											

BM1030	BIOMEDICAL CONTROL SYSTEMS LAB	L	T	P	C
	Total contact Hours - 30	0	0	2	1
	Prerequisite				
	Nil				

PURPOSE

To study and analyze application of the many classical and modern control system design and analysis tools is based on mathematical model

INSTRUCTIONAL OBJECTIVES

1.	To study the characteristics of various controllers
2.	To analyze the stability of the system.

LIST OF EXPERIMENT

1. Introduction to Root Locus
2. Controller Design Using Root Locus
3. Introduction of Bode plots, phase and gain margin
4. Control system design using bode plot-lead ,lag and lead lag controllers
5. Lung mechanics model using SIMULINK
6. Simulation of Hodgkin-Huxley model
7. Steady state analysis of muscle stretch reflex model
8. Second order lung mechanics model to a unit step response
9. Neuromuscular reflex model using VI
10. Nyquist stability analysis of respiratory control model

REFERENCE

1. Control System Laboratory Manual

BM1030 BIOMEDICAL CONTROL SYSTEMS LAB												
Course designed by		Department of Biomedical Engineering										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
						x			**x**			
2	Mapping of instructional objectives with student outcome					**5**			**4**			
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)			

4	Broad area (for "P"category)	Biomedical Electronics Engg	Basics of biomedical Engg	Biomedical Instrumentation Engg	Biomedical Imaging Engg	Health care Engg
				x		
5	Approval	23rd meeting of Academic Council, May 2013				

	VIRTUAL INSTRUMENTATION DESIGN FOR MEDICAL SYSTEMS LAB	L	T	P	C
BM1031	Total contact Hours - 30	**0**	**0**	**2**	**1**
	Prerequisite				
	Nil				

PURPOSE

To impart adequate knowledge on programming in Virtual Instrumentation for acquisition and analysis of signals in medical system

INSTRUCTIONAL OBJECTIVES

1.	To educate about the Basic concepts of VI
2.	To make them understand the programming concepts of VI.
3.	To provide an insight to various Common Instrument Interface.
4.	To enable them to implement VI in medical systems
5.	To impart knowledge on various analysis tools

List of Experiments

1. Basic arithmetic operations
2. Boolean operations
3. Sum of 'n' numbers using 'for' loop
4. Factorial of a give number using for loop
5. Sum of 'n' natural numbers using while loop
6. Factorial of a give number using while loop
7. Sorting even numbers using while loop in an array
8. Array maximum and minimum
9. Bundle and unbundle cluster
10. Flat and stacked sequence
11. Application using formula node
12. Convolution of two signals
13. Windowing techniques
14. Instrumentation of an amplifier to acquire an ECG signal using NI vision acquisition software

15. To measure BP, heart rate, temperature, ECG using vernier biomedical sensor kit
16. Acquire, analyse and present an EEG instrumentation using NI ELVIS hardware

REFERENCES

1. Virtual instrumentation lab manual

BM1031 VIRTUAL INSTRUMENTATION DESIGN FOR MEDICAL SYSTEMS LAB												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
				x		**x**						**x**
2	Mapping of instructional objectives with student outcome			**2**		**5**						**2**
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)					Professional Subjects (P)	
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									x			
5	Approval	23rd meeting of Academic Council, May 2013										

BM1048	**INDUSTRIAL TRAINING II**	**L**	**T**	**P**	**C**
	2 Week practical training in Industry	**0**	**0**	**1**	**1**
	Prerequisite				
	Training to be undergone after VI semester				

PURPOSE

To provide hands-on experience at site where biomedical equipments are manufactured and utilized (Hospitals)

INSTRUCTIONAL OBJECTIVES

1.	To enable the students to gather a first hand experience on usage of various biomedical equipments.
2.	To be familiar with various medical imaging techniques.
3.	To gain some practical experience in servicing the equipments.

INDUSTRIAL TRAINING II

Students have to undergo two weeks practical training in biomedical equipments manufacturing companies or hospitals but with approval of the department. At the end of the training student will submit a report as per the prescribed format to the department.

ASSESSMENT PROCESS

This course is mandatory and the student has to pass the course to become eligible for award of the degree. The student shall make a presentation before a committee constituted by the department which will assess the student based on the report submitted and the presentation made.Marks will be awarded out of 100 and appropriate grades assigned as per the regulations.

<table>
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BM1050	MAJOR PROJECT / PRACTICE SCHOOL	L	T	P	C
	Prerequisite	0	0	24	12
	Nil				

PURPOSE

To simulate real life situations related to Biomedical Engineering and impact adequate training so that confidence to face and tackle any problem in the field is developed in the college itself.

INSTRUCTIONAL OBJECTIVES

1.	To guide the students such a way that the students carry out a comprehensive work on the chosen topic which will stand them in good stead as they face real life situation.

PROJECT

Hardware/ Numerical/Theoretical research and development work is to be allotted. A maximum number of three students may be involved in each project. However the contribution of the individuals in the project should be clearly brought out. The combined project report is to be submitted as per the university regulations. A seminar has to be presented on the allotted topic. All the students involved in the project will be examined for their contribution.

Guidance is given to the students which will cover all the areas in Biomedical Engineering like Designing (Biomedical Equipments), Analysis, Simulation, Processing of bio-signals (ECG, EMG, EEG, EOG, ERG, etc.,) and medical images (MRI, CT,PET, etc.,) Alternately, a few research problems also may be identified for investigation and the use of laboratory facilities to the full extent may be taken as project work. Alternately, a student is encouraged to take an industrial project with any Biomedical Engineering Organization or Multi-specialty Hospital. A project report is to be submitted on the topic which will be evaluated.

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DEPARTMENTAL ELECTIVES

I. BIOMEDICAL SERVICE ENGINEER

BM1101	**COMMUNICATION CIRCUITS AND SYSTEMS**	**L**	**T**	**P**	**C**
	Total contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE	
To impart knowledge about transmission of analog and digital information using various modulation techniques and methods of enabling secured communication.	
INSTRUCTIONAL OBJECTIVES	
1.	To understand the different types of AM Communication systems
2.	To study in detail about the different types of FM Communication systems
3.	To familiarize about the base band data Communication systems
4.	To gain knowledge about the different digital communication techniques
5.	To know the spread spectrum modulation techniques and error control coding techniques

UNIT I - AMPLITUDE MODULATION (AM) (9 Hours)

Modulation – Need of modulation, Mathematical representation of AM- DSB SC, AM-SSB SC, AM-VSB AM, Frequency spectrum, Bandwidth, power relation, Generation of AM – square law modulator and balanced modulator, Detection of AM: square law detector, envelope detector, AM transmitter, AM receiver –TRF and super heterodyne receiver.

UNIT II - FREQUENCY MODULATION (FM) (9 Hours)

Mathematical representation of Frequency modulation, Frequency spectrum, Band Width, Generation of FM- Varactor diode modulator-Armstrong modulator, FM detection- Foster seely discriminator-Ratio detector, FM transmitter, FM receiver, Applications of FM, Advantages and Disadvantages of FM

UNIT III - BASE BAND DATA COMMUNICATION (9 Hours)

Sampling, Sampling Theorem, Quantization, PCM, ADPCM, DM, ADM, Base band pulse shaping: binary data formats, ISI, Nyquist criterion for distortion less baseband binary transmission.

UNIT IV - DIGITAL MODULATION TECHNIQUES (9 Hours)

Digital modulation Formats-ASK,FSK, PSK, Analog to Digital Conversion-PAM, PWM, PPM, Coherent binary-, and quadrature- modulations, and Non--coherent binary modulation: M-ary modulation.

UNIT V - SECURED COMMUNICATION AND MULTIPLE ACCESS TECHNIQUES (9 Hours)

Introduction to spread spectrum, Pseudo-noise sequence, DS spread spectrum, processing gain, FH spread spectrum, multiple access techniques: FDMA, TDMA, CDMA.

TEXT BOOKS

1. Bernard Sklar and Pabitra Kumar Ray, "*Digital Communications: fundamentals and practice*", 2nd edition, pearson edition, 2001
2. Herbert Taub, Donald L Schilling & Goutam Saha, "*Principles of Communication Systems",* Third Edition , Tata McGraw Hill Publication, 2008

REFERENCES

1. Simon S. Haykins and , Michael Mosher, *"Digital Communication"*, John Wiley & sons, 2001
2. John G. Proakis, Masoud Salehi, "*Digital Communication"*, fifth edition , McGraw-Hill Higher Education, 2008

BM1101 COMMUNICATION CIRCUITS AND SYSTEMS												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
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		x										
5	Approval	23rd meeting of Academic Council, May 2013										

BM1102	BIOMEDICAL LASER INSTRUMENTATION	L	T	P	C
	Total contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To understand the fundamentals of different types of laser, its operations and applications in medical field.

INSTRUCTIONAL OBJECTIVES

1.	To study in-depth the principle of laser action and the characteristics of laser
2.	To study about various types of laser and its mode of operation
3.	To study various applications of lasers in medical field
4.	To study and understand about holography and its applications
5.	To design the experimental setup and can able to analyze the data.

UNIT I - OPTICAL PROPERTIES OF TISSUES (9 Hours)

Reflection, Scattering- Absorption- Refractive Index - Light transport inside the tissue - Interaction of light with matter - quantum behavior of light - Light interaction with tissues - Optothermal interaction – Fluorescence - Speckles

UNIT II - BASIC THEORY OF LASER (9 Hours)

LASER action : stimulated & spontaneous emission- Molecular energy level - characteristics of laser- population inversion - Pumping methods and levels of pumping- Optical cavity configurations –Amplification - Optical resonator and gain - Q-switching - Mode locking- LASER modes - Line broadening

UNIT III - TYPES OF LASER (9 Hours)

Solid state, Ruby, Nd:YAG, Tunable solid state, Alexandrite, Gas lasers: Helium-Neon, Argon, Co_2 - Tunable dye laser - Semiconductor laser.

UNIT IV - HOLOGRAPHY AND ITS MEDICAL APPLICATIONS (9 Hours)

Holography – Basic principle- methods of Holographic interferometry – applications - Holography for non-destructive testing –applications of LASER holography in medicine: Dentistry, Ophthalmology, Otology, Orthopedics.

UNIT V - MEDICAL APPLICATIONS OF LASER (9 Hours)

Photo-chemical interaction- Thermal interaction- Photoablation - Plasma induced ablation – photo-disruption- Applications: Ophthalmology, Dentistry, Urology, Neurosurgery, Dermatology, Orthopedics, Angioplasty, Cardiology, and Surgery-Diffused optical tomography.

TEXT BOOKS

1. Thyagarajan K, Ajoy K. Ghatak A,"*Lasers Fundamentals and Applications*", Second edition, Springer 2010.
2. Markolf H. Niemz, *"Laser-Tissue Interactions: Fundamentals and Applications*", Third edition, Springer 2007.

REFERENCES

1. Keiser, *"Optical Fiber Communication Systems*", Mc Graw Hill Ltd., Third edition,1983.
2. John E. Harry, "*Industrial lasers and their applications*", Second edition, McGraw Hill, 1974.
3. John F Ready, "*Industrial applications of lasers*", Second edition, Academic Press, 1978.

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BM1103	NUCLEAR MEDICINE	L	T	P	C
	Total contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To understand the fundamentals of Nuclear Medicine and learn about the instruments involved in production techniques and therapeutic uses of Nuclear Medicine.

INSTRUCTIONAL OBJECTIVES

1.	To learn the basics of nuclear medicine
2.	To study the construction and principle of operation of various nuclear medicine instruments.
3.	To have some knowledge about the characteristics and mechanisms of radiopharmaceuticals
4.	To study the diagnostics and therapeutic applications of nuclear medicine.
5.	To have idea about the radiation safety procedures and regulations.

UNIT I - BASICS OF NUCLEAR MEDICINE (8 Hours)

Radioactivity and interaction of radiation; Alpha, Beta and gamma emission, Laws of radioactive decay, Mechanisms of radioactive delay, Radiation intensity and exposure, Decay schemes and energy levels, Compton scattering, Pair productions, Particle interactions

UNIT II - RADIOPHARMACEUTICALS (9 Hours)

Radionuclide production, $^{99}Mo/^{99m}Tc$ generator, Mechanism of localization, Types of radiopharmaceuticals, characteristics of radio pharmaceuticals, Radiopharmaceuticals for diagnosis and treatments in human, Dispensing of radio pharmaceuticals, RIA radiopharmaceuticals and kits production.

UNIT III - NUCLEAR MEDICINE INSTRUMENTATION (9 Hours)

Construction and principle operation of Gamma camera, Rectilinear scanner, Basic principles of pulse height analyser, Radiation detectors-Ionization chamber, Geiger Muller counter, Semiconductor detectors, Scintillation detectors, Electronic Instrumentation for radiation detection system,

UNIT IV - DIAGNOSTIC AND THERAPEUTIC APPLICATIONS OF RADIONUCLIDE (10 Hours)

PET-CT, Single photon emission computed tomography (SPECT), Radio iodine therapy for Thyrotoxicosis , Differentiated thyroid cancers, Palliative treatment for bone metastasis - ^{32}P and 89 Strontium Dosage, Intravascular particulate radio

nuclide Therapy, Receptor targeted therapy, ^{131}I- MIBG Therapy, Targeted internal radiation in HCC: 90 Y, Radio-synovectomy using Yttrium

UNIT V - RADIATION SAFETY **(9 Hours)**

Radiation protection indifferent nuclear isotope therapy procedures, Management of radiation accidents, Diagnosis, evaluation and treatment of radiation overexposure, Instruments used in radiation survey & monitoring, Handling of radioactive patients, Role of national and international bodies in radiation safety, ICRP recommendations, BARC regulations regarding limits of radiation exposure

TEXT BOOKS

1. Simon Cherry, James Sorenson, Michael Phelps. "*Physics in Nuclear Medicine*", Elsevier Saunders , 4th Edition ,2012
2. Jennifer Prekeges, "*Nuclear Medicine Instrumentation*", Jones and Barlett publishers, 1st edition, 2011

REFERENCES

1. Max.H.Lombardi, "*Radiation safety in Nuclear Medicine*", CRC Press, Florida, USA, 2nd edition 1999.
2. Terold D.T. Bushberg, J. Antony, "*The Essential Physics of Medical Imaging*", LWW; Third, North American Edition, 2011.

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BM1104	RADIOTHERAPY EQUIPMENTS	L	T	P	C
	Total contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE	
To provide the ability to work in different radiotherapy Equipments and its applications in Biomedical Engineering	
INSTRUCTIONAL OBJECTIVES	
1.	To make them understand the basics of radiotherapy physics
2.	To impart the knowledge about the different pretreatment imaging and treatment verification
3.	To gain in-depth knowledge about the radiotherapy effects
4.	To make the students understand the function of various types of Radiotherapy equipments

UNITI- RADIOTHERAPY PHYSICS & PRE-TREATMENT IMAGING

(10 Hours)

Atoms, nuclei and radioactivity- Radiation interactions with matter- Radiation measurement and detection- Imaging with X-ray, MRI and ultrasound-Imaging with radio nuclides- Therapy with unsealed radio nuclides-Radiotherapy beam production.

UNIT II - RADIATION TREATMENT PLANNING (9 Hours)

Immobilization, localization and verification techniques- Principles and practice of radiation treatment planning- Brachytherapy-Networking, data and image handling and computing in radiotherapy- Quality management in radiotherapy.

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UNIT III – RADIOTHERAPY EFFECTS (9 Hours)

Epidemiology of cancer-screening- Biological and pathological introduction- Molecular, cellular and tissue effects of radiotherapy- Principles and management of patients with cancer- Chemotherapy and hormones- Skin and lip cancer-head and neck cancer.

UNIT IV - RADIOTHERAPY ASSISTING DEVICES (8 Hours)

Features of conventional simulator and modern simulator - Immobilization equipment for head, neck, pelvic and extremities.

UNIT V - ADVANCED APPLICATIONS (9 Hours)

Cobalt units, Gamma knife, Linear accelerators, Helical tomotheraphy, Ancillary equipment – Superficial and ortho voltage equipment

TEXT BOOKS

1. Symonds, Deehan, Meredith & Mills Walter and Miller, "*Textbook of Radiotherapy: Radiation Physics, Therapy and Oncology",* Churchill Livingstone, Seventh Edition, 2012**.**
2. Pam Cherry, Angela Duxbury, "*Practical Radiotherapy-Physics and Equipment",* John Wiley & Sons, Second Edition, 2009.

REFERENCES

1. Todd Powliki, Peter B. Dunscombe, Arno J. Mundt, Pierre Scalliet, "Quality *and safety in radiotherapy",* CRC Press, First Edition,2010.
2. Subramania Jayaraman,Lawrence H. Lanzl, "*Clinical Radiotherapy Physics",* CRC Press, Second Edition, 1996.

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BM1105	**MEDICAL RADIATION SAFETY ENGINEERING**	**L**	**T**	**P**	**C**
	Total contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Basic knowledge of radiation protection and safety measures				

PURPOSE	
To impart sufficient information on the various precautionary and safety measures for radiation protection in medicine.	
INSTRUCTIONAL OBJECTIVES	
1.	To provide an insight to the basics of radiation physics.
2.	To enable them understand the guidelines of radiation protection and radiation detectors.
3	To provide information on safety measures related to UV, laser and nuclear medicine

UNIT I - INTRODUCTION TO RF AND MICROWAVE RADIATION (9 Hours)

Sources of radio frequency radiation- Effects of radio frequency radiation- Development of standards for human safety- Calculation of RF field quantities- RF radiation measuring instruments and methods.

UNIT II - RADIATION DETECTION AND MEASUREMENT (9 Hours)

Fundamentals of radiation detection- Conducting radiation measurements and surveys- Gas detectors- Designing to reduce radiation hazards- Radio frequency radiation safety management and training-Scintillation detectors- Statistics of counting- minimum detectable activity- Quality assurance of radiation counters.

UNIT III -RADIATION SAFETY IN NUCLEAR MEDICINE AND RADIOTHERAPY (9 Hours)

Design and description of NM department- Radiation protection in nuclear industry- Guidelines for radiation protection- Molecular medicine and radiation safety program- procedures for safe operation of radiation equipment- Radiation protection in external beam radiotherapy- Radiation protection in brachytherapy- Radioactive wastes.

UNIT IV - LASER AND ULTRAVIOLET RADIATION SAFETY (9 Hours)

Classification of UV radiation -Sources of UV- Biological effects of UV- Hazards associated with UV radiation- UV control measures - Safety management of UV- Classifications of LASER and its radiation hazards- control measures- Emergencies and incident procedures.

UNIT V - MONITORING AND INTERNAL DOSIMETRY (9 Hours)

Monitoring methods-personal radiation monitoring- Records of personal dosimetry- ICRP method- MIRD method- Internal doses from radiopharmaceuticals- Bioassay of radioactivity-Hazard and risk in radiation protection- radiological incidents and emergencies- Regulation to radiation protection

TEXT BOOKS

1. Jamie V Trapp, Thomas Kron, "*An introduction to radiation protection in medicine*", crc press Taylor &Francis group, 2008
2. Alan Martin, Samuel Harbison, Karen Beach, Peter Cole, Hodder Arnold, "*An introduction to radiation protection",* 6th edition 2012

REFERENCES

1. Max Hlombardi, *"Radiation safety in nuclear medicine",* CRC Press Taylor &Francis group, 2nd edition ,2007
2. Aruna Kaushik, Anupam mondal, B.S. Dwarakanath, R.P.Tripathi, "*Radiation protection manual*", INMAS, DRDO, 2010.
3. Ronald kitchen, *"RF and microwave radiation safety*", Newness publishers, 2nd edition, 2001.

BM1105 MEDICAL RADIATION SAFETY ENGINEERING												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
							X			**X**		
2	Mapping of instructional objectives with student outcome						**2**			**1**		
3	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)				Professional Subjects (P)	
											x	
4	Broad area (for "P"category)	Biomedical Electronics Engg		Basics of biomedical Engg			Biomedical Instrument ation Engg		Biomedical Imaging Engg		Health care Engg	
											x	
5	Approval	23rd meeting of Academic Council, May 2013										

BM1106	QUALITY CONTROL AND REGULATORY ASPECTS IN MEDICAL DEVICES	L	T	P	C
		3	0	0	3
	Total contact Hours - 45				
	Prerequisite				
	Nil				

PURPOSE

The course is designed to make the student better understanding of Quality standards and management methodologies in Biomedical Engineering.

INSTRUCTIONAL OBJECTIVES

1.	To understand the various quality standards & regulations used for healthcare
2.	To get an overview of various methodologies used for management in healthcare

UNIT I - FUNDAMENTALS OF QUALITY MANAGEMENT (9 Hours)

Definition of Quality, Dimensions of Quality, Quality Planning - Quality costs. - Analysis Techniques of quality Cost - Basic concepts of Total Quality Management, Historical Review. - Principles of TQM, Leadership – Concepts, Role of Senior Management - Quality Council, Quality Statements - Strategic Planning - Deming Philosophy - Barriers to TQM Implementation

UNIT II - QUALITY MANAGEMENT PRINCIPLES (9 Hours)

Customer satisfaction – Customer Perception of Quality - Customer Complaints, Service Quality, Customer Retention - Employee Involvement – Motivation, Empowerment - Teams and Team Work - Recognition and Reward, Performance Appraisal, Benefits - Continuous Process Improvement – Juran Trilogy - PDSA Cycle, 5S, Kaizen

UNIT III - STATISTICAL PROCESS CONTROL (9 Hours)

Seven Tools of Quality, concept of six sigma, New seven management tools, statistical fundamentals- Measures of central Tendency and Dispersion, Population and Sample - Normal Curve, Control Charts for variables and attributes, Process capability

UNIT IV - TQM TOOLS (9 Hours)

Benchmarking – Reasons to Benchmark - Benchmarking Process - Quality Function Deployment (QFD) – House of Quality - QFD Process - Benefits - Taguchi Quality Loss Function - Total Productive Maintenance (TPM) – Concept, Improvement Needs - FMEA – Stages of FMEA

UNIT V - REGULATORY ORGANIZATIONS IN MEDICINE (9 Hours)

Need for ISO 9000 and Other Quality Systems - ISO 9000:2000 Quality System – Elements, Implementation of Quality System - Quality Auditing - Need for Accreditation of hospitals - FDA Regulations- Joint Commission - Regulatory Bodies of India-Medical Council of India - Pharmacy Council Of India, Indian Nursing Council - Dental Council of India, Homeopathy Central Council

TEXT BOOKS

1. Rose, J.E., "*Total Quality Management*", Kogan Page Ltd., 1993
2. Cesar A. Cacere & Albert Zana, :*The Practise of clinical Engineering".* Academic Press, Newyork, 1997

REFERENCES

1. John Bank, "*The Essence of Total Quality Management*", Prentice Hall of India, 1993
2. Webster J.G and Albert M.Cook, "*Clinical Engineering, Principles & Practices"*, Prentice Hall Inc., Engle wood cliffs, New Jersey, 1979

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BM1107	**TROUBLESHOOTING OF MEDICAL INSTRUMENTS**	**L**	**T**	**P**	**C**
	Total contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Basic knowledge of circuit analysis & electronic devices				

PURPOSE

To provide knowledge to students to enable them to troubleshoot the various equipments used in hospitals.

INSTRUCTIONAL OBJECTIVES

1.	To provide adequate technical information on operating principles of medical instruments to attain mastery in fault detection and corrective measures.

UNIT I - FUNDAMENTAL TROUBLESHOOTING PROCEDURES (9 Hours)

Making of an Electronic Equipment, causes of Equipment Failure, Troubleshooting Process & Fault finding Aids, Troubleshooting Techniques, Grounding Systems in Electronic Equipment, Temperature Sensitive Intermittent Problems, and Correction Action to repair the Equipment.

UNIT II - TESTING OF PASSIVE COMPONENTS & SEMICONDUCTOR DEVICES (8 Hours)

Testing: resistors, capacitors & inductors, causes of failure for electronic components, testing procedure for semiconductor devices: special diodes, bipolar transistors, field effect transistor (FET), and thyristor.

UNIT III - FAULT DIAGNOSIS IN ANALOG & DIGITAL INTEGRATED CIRCUITS (8 Hours)

Fault Diagnosis in Op-Amp Circuits, Digital Troubleshooting Methods, Digital IC Troubleshooters, Circuit board Troubleshooting.

UNIT IV - BIOMEDICAL EQUIPMENT TROUBLESHOOTING –I (10 Hours)

Trouble shooting of ECG Machine, EEG Machine, Defibrillator Electrosurgical unit, Anaesthesia machine, Autoclaves & sterilizers, Endoscope.

UNIT V - BIOMEDICAL EQUIPMENT TROUBLESHOOTING –II (10 Hours)

Troubleshooting of Incubators, Nebulizer, Oxygen Concentrators, Oxygen cylinders & flow meters, Pulse Oximeter, Sphygmomanometers, Suction Machine, X-Ray Machine Troubleshooting.

TEXT BOOKS

1. Khandpur R S, "*Troubleshooting Electronic Equipment- Includes Repair & Maintenance"*, Tata McGraw-Hill, Second Edition 2009
2. Dan Tomal & Neal Widmer, "*Electronic Troubleshooting",* McGraw Hill, 3rd Edition 2004

REFERENCES

1. Nicholas Cram & Selby Holder, "*Basic Electronic Troubleshooting for Biomedical Technicians"*, TSTC Publishing, 2nd Edition 2010
2. World Health Organisation, "*Maintenance & Repair of Laboratory, Diagnostic imaging & Hospital Equipment"*, Geneva,1994
3. Ian R McClelland , "*X-ray Equipment maintenance & repairs workbook for Radiographers & Radiological Technologists*", World Health Organisation, Geneva, 2004
4. Ministry of Health & Family Welfare, "*Medical Equipment Maintenance Manual- A first line maintenance guide for end users"*, New Delhi, October 2010
5. Joseph J Panichello, "*X-Ray Repair : A Comprehensive Guide to the Installation & Servicing of Radiographic Equipment*", Charles C Thomas Publisher Ltd, 2nd Edition 2005

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II. APPLICATION SPECIALIST

BM1108	**HOSPITAL ENGINEERING**	**L**	**T**	**P**	**C**
	Total contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Basic knowledge of planning and designing of hospital services				

PURPOSE

To provide the knowledge of planning ,designing and safety management in hospital services

INSTRUCTIONAL OBJECTIVES

1.	To obtain the knowledge about the basic planning and organization of hospitals
2.	To study about the clinical services
3	To impart knowledge on designing of hospital services
4	To study and analyze the infection control and safety management in hospitals

UNIT I - PLANNING AND ORGANIZATION OF THE HOSPITALS (9 Hours)

Roles of hospital in healthcare-hospital planning and design-outpatient services-nursing unit-intensive care unit-nursing services.

UNIT II - CLINICAL SERVICES (9 Hours)

Radiology and imaging services-laboratory services-operation theatre suite-pharmacy-central sterile supply department.

UNIT III - DESIGNING OF HOSPITAL SERVICES (9 Hours)

Engineering department - maintenance management- clinical engineering- electrical system- air conditioning system- water supply and sanitary system- centralized medical gas system-communication system

UNIT IV - SUPPORT SERVICES AND SAFETY MANAGEMENT (9 Hours)

Admitting department- medical records department- food service department- laundry and linen service-housekeeping- safety in hospital-fire safety - disaster management.

UNITV- INFECTION CONTROL AND WASTE MANAGEMENT (9 Hours)

Importance of infection control-hand hygiene-clinical laboratory standards to infection control-health care workers safety-solid waste management and transportation

TEXT BOOKS

1. Kunders G.D, "*Biomechanics: Hospitals, facilities planning and management",* Tata Mcgraw Hill, 16th edition, 2004.
2. Sakharkar B.M, "*Principles of hospital administration and planning*", Jaypee Brothers Medical Publishers Pvt Limited, 2nd edition, 2009

REFERENCES

1. Sanjiv Singh, Sakthikumar Gupta, Sunil Kant, "*Hospital infection control guidelines, principles and practice"*, Jaypee Brothers Medical Publishers Pvt Limited, First edition, 2012.

BM1108 HOSPITAL ENGINEERING													
Course designed by		**Department of Biomedical Engineering**											
1	Student outcome	a	b	c	d	e	f	g	h	i	j	K	
					X				**X**	**X**			
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										x			
5	Approval	23rd meeting of Academic Council, May 2013											

BM1109	**TELEMEDICINE AND PICTURE ARCHIVAL COMMUNICATION SYSTEM (PACS)**	**L**	**T**	**P**	**C**
	Total contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				
PURPOSE					
To enable the students to acquire knowledge about the principles of Telemedicine and Picture Archival Communication System					
INSTRUCTIONAL OBJECTIVES					

1.	To learn the fundamental concepts necessary to for any telemedicine and tele-health activity
2.	To know the importance of secure medical data transmission and retrieval
3.	To study the need for digital imaging and picture archiving and communication systems (PACS)

UNIT I - HISTORY OF TELEMEDICINE AND COMMUNICATION TECHNOLOGIES (9 Hours)

Telemedicine: Definition and history, Block diagram, Scope, Benefits, Limitations, and Clinical applications - Real-time and store-forward, 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 (GSM, Satellite and Micro-wave), Types of antennas depending on requirements

UNIT II - MEDICAL DATA SECURITY AND LEGAL ISSUES (9 Hours)

Data Exchanges: Network configuration, Video conferencing- Data security and Standards: Encryption, Cryptography, Mechanisms and phases of encryption- Protocols and Standards -encryption, Ethical and legal aspects of Telemedicine, patient rights and consent form, access to medical records, Intellectual property rights

UNIT III - TELE-RADIOLOGY & TELE-PATHOLOGY (9 Hours)

Tele-radiology and its basic system components, Image acquisition system, Display system, Communication networks, Interpretation, Tele-pathology, Multimedia databases, color images of sufficient resolution, image compression methods, Interactive control of color and controlled sampling

UNIT IV - OTHER MEDICAL APPLICATIONS (9 Hours)

Tele-dermatology, Tele-psychiatry, Tele-cardiology, Tele-trauma, role of tele-education, evaluation in telemedicine, Tele-oncology, Tele-surgery, security and confidentiality tools

UNIT V - PICTURE ARCHIVAL COMMUNCIATION SYSTEMS (PACS) (9 Hours)

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)

TEXT BOOKS

1. Olga Ferrer-Roca, M.Sosa Ludicissa, "*Handbook of Telemedicine"*, IOS press 2002.
2. Norris A.C, "*Essentials of Telemedicine and Telecare*", John Wiley & Sons, 2002.
3. Wootton, R., Craig, J, Patterson, "*Introduction to Telemedicine*" Royal Society of Medicine Press Ltd. , (2nd ed.), 2006

REFERENCES

1. Maheu M.M., Whitten P., Allen A, "*E-Health, Telehealth, and Telemedicine"* Jossy-Bass., 2001
2. Keith J.Dreyer, David S.Hirschron, James H.Thrall, Amit Mehta, *PACS: "AGuide to the Digital Revolution"*, 2nd Edition, Springer
3. H.K. Huang, "*PACS and imaging informatics – Basic Principles & application*", Wiley-Blackwell
4. Latifi, R. "*Current Principles and Practices of Telemedicine and e-Health"*. Washington DC: IOHS , 2008
5. Bashshur, R.L., Shannon, G.W. "History of Telemedicine". New Rochelle, NY: Mary Ann Liebert Publishers. ,2009

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BM1110	ADVANCED MEDICAL IMAGING SYSTEMS	L	T	P	C
	Total contact Hours - 45	3	0	0	3
	Prerequisite				
	Basic knowledge of medical imaging techniques				

PURPOSE

To introduce the students to advanced medical imaging techniques enabling the students to work professionally in the biomedical engineering sector and other medical imaging related industry in designing systems, components, products or processes to meet desired needs of these industries in health care wing.

INSTRUCTIONAL OBJECTIVES

1.	To study about fluoroscopic imaging techniques and components.
2.	To learn about the principle, reconstruction ,artifacts with CT imaging
3.	To understand the basics and advancement in fMRI
4.	To learn about microwave and infrared medical imaging modalities.
5.	To understand the concepts of radioisotope and nuclear imaging

UNIT I - FLUOROSCOPY (9 Hours)

Fluoroscopic imaging chain components - Characteristics of Image intensifier performance - Modes of operation - Image quality - Radiation dose - Fluoroscopic suites - Peripheral equipment - Optical coupling - Video cameras

UNIT II - COMPUTED TOMOGRAPHY (9 Hours)

Basic Principles - Geometry and Historical Development - Detectors and Detector Arrays - Details of Acquisition - Tomographic Reconstruction - Digital Image Display - Radiation Dose, Image Quality – Artifacts

UNIT III - fMRI (9 Hours)

Introduction to fMRI - Basics of MRI Signal, Tissue contrast and spatial localization - Neuronal activity and Hemodynamics - BOLD fMRI - SNR in fMRI - Experimental design - fMRI statistics 1and 2 - Advanced fMRI

UNIT IV - MICROWAVE AND INFRARED IMAGING (9 Hours)

Introduction, Electromagnetic scattering - Elecromagnetic inverse scattering problem - Imaging configuration - Model approximations - Qualitative reconstruction methods - Microwave imaging apparatus - Infrared imaging- Thermography - Clinical applications of thermography - liquid crystal thermography.

UNIT V - RADIO ISOTOPE IMAGING AND NUCLEAR MEDICINE (9 Hours)

Radio nuclides for imaging: Cyclotron, Nuclear reactor, and Generator production –

Rectilinear, and linear scanners- SPECT- PET - Gamma Camera - Comparison of tomographic techniques - Radiation dosimetry- Radiation protection.

TEXT BOOKS

1. Jerrold T. Bushberg, J.Anthony Seibert, Edwin M. Leidholdt, JR, John M.Boone, "*The Essential Physics of Medical Imaging*", Lippincott Williams & Wilkins, USA, Second Edition 2001.

2. R.S. Khandpur, *"Hand-book of Biomedical Instrumentation",* Tata McGraw Hill, 2nd Edition, 2003.

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1. William R.hendee, E.Russell Ritenour, "*Medical imaging physics*", Fourth Edition, 2002
2. Stephan Ulmer, Olav Jansen, "*FMRI: Basics and Clinical Applications*", springer, first Edition, 2010
3. Matteo Pastorin, "*Microwave imaging"*, John Wiley and Sons ,first edition, 2010.

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	ADVANCED DIAGNOSTIC AND SURGICAL EQUIPMENTS	L	T	P	C
BM1111	Total contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Basic knowledge of medical equipments				

PURPOSE

To gain basic knowledge about ICU equipments, neonatal equipments and safety measures for bio medical equipments and to give a complete exposure to working of advanced surgical and diagnostic lab equipments.

INSTRUCTIONAL OBJECTIVES

1.	To study the various ICU and neonatal equipments
2.	To understand concept of the Neurological equipments
3.	To study about Diagnostic of lab equipments
4.	To study about surgical O.T equipments
5.	To understand the surgical of scopy and diathermy equipments

UNIT I - ICU EQUIPMENTS AND NEONATAL EQUIPMENTS (9 Hours)

Oxygen concentrators – Capnographs monitoring systems - cardiac monitor, multipara monitor - Advanced defibrillators –internal and external - Intermediate level of suction apparatus – Laryngoscope - Advance level of radiant warmer, phototherapy units - Doppler fetal heart rate device (handheld type), Fetal Cardiac Tocography, Baby Incubator, Neonatal ventilator

UNIT II - DIAGNOSTIC NEUROLOGICAL EQUIPMENTS (8 Hours)

Stereo toxic unit- depth recording system-Diffusion optical Tomography Scanner-transcutaneous nerve Stimulator- anesthesia monitor - EEG controlled anesthesia-bio-feedback equipments, Spinal reflex measurements.

UNIT III - DIAGNOSTIC LAB EQUIPMENTS (10 Hours)

Basic Blood gas analyzer - Photo meter and spectro photometer - Microtome, osometer, Lab freezer - PH meter, Optical microscope - Water bath types, Centrifuge (table), Shakers, Lab, laminar air flow units - Lab precision balances, Incubator and Heating unit centrifuge (Flour) - Electrophoresis systems, tissue embedding equipment - Ambulance setup

UNIT IV - SURGICAL EQUIPMENTS (9 Hours)

Electrosurgical units, Warmer (Blood and Patient) - tourniquet, insufflators, irrigation unit - Operating microscope - arthroscopy, Operation Theater (OT): Lights, and Patient"s tables - Flow meters (gas & blood), sterilizing units (auto clave), Sterilizing producers, Surgical driller , manifold unit – Central supply of air.

UNIT IV - SURGICAL SCOPY AND DIATHERMY EQUIPMENTS (9 Hours)

Laparoscope, Gastro scope, endoscopes -light sources. Bronchoscope: Video processors, Camera, and Fiber optic cable. Depth of penetration and physiological effects of H.F. radiation- Short wave-Ultra Sonics and Microwave diathermy- Surgical diathermy, physiological effects of stimulation, galvanic, Faradic and surged types, interferential therapy.

TEXT BOOKS

1. Albert M.Cook and Webster.J.G. "*Therapeutic Medical Devices*", Prentice Hall Inc., New Jersey, 1982.
2. Geddes L.A and Baker L.E, "*Principles of Applied Biomedical Instrumentation",* John Wiley, 3rd Edition, 1975, Reprint 1989.
3. Khandpur R.S, *"Hand-book of Biomedical Instrumentation",* Tata McGraw Hill, 2nd Edition, 2003.

REFERENCES

1. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, *"Biomedical Instrumentation and Measurements"*, Prentice-Hall India, 2nd Edition,1997
2. John G. Webster, "Medical *Instrumentation application and design*", JohnWiley, 3rd Edition, 1997
3. Fein Berg B.N., "Applied Clinical Engineering", Prentice Hall Inc., New Jersey, 1986.

BM1111 ADVANCED DIAGNOSTIC AND SURGICAL EQUIPMENTS												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
			X									**X**
2	Mapping of instructional objectives with student outcome		**1**									**2**
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)		
										x		
4	Broad area (for "P"category)	Biomedical Electronics Engg		Basics of biomedical Engg		Biomedical Instrument ation Engg		Biomedical Imaging Engg		Health care Engg		
						X						
5	Approval	23rd meeting of Academic Council, May 2013										

BM1112	HOSPITAL RADIOPHARMACY	L	T	P	C
	Total contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To understand the ability in performing the manipulative and record keeping functions associated with the compounding and dispensing of Radiopharmaceuticals in Hospital

INSTRUCTIONAL OBJECTIVES

1.	To provide students with knowledge of nuclear medicine centers , setting up and running radio-pharmacy service
2.	To know about the quality control and role of PET in nuclear medicine
3.	To gain knowledge about the radiation safety and radiation protection
4.	To understand the concept of procedures and operations relating to the reconstitution, packaging and labeling of radiopharmaceuticals
5.	To provide clear boundaries for different levels of radio-pharmacy operations with a view for more definitive advice on staff qualifications, training and facilities

UNIT I - TYPES OF RADIATION, & RADIONUCLIDE (9 Hours)

Introduction to radiation, Practical types of radiation, Radioactive component - importance of shielding - containers in operations - importance of distance in radiation interaction with matter - Radionuclide calibrators, Radiation safety - Production of radionuclides- Tc-99m generator

UNIT II - OPERATION & STAFFING (9 Hours)

Radiopharmacy operations - Good radio-pharmacy practice in hospital radio-pharmacy - Design of facilities - Introduction to diagnosis with radio-pharmacy - Standard operating procedures (SOP)

UNIT III - GUIDANCE FOR OPERATIONAL LEVEL 1A, 1B, 2A, 2B (9 Hours)

Guidance for Operational Level 1a, 1b, 2a, and 2b: Staff and Training, facilities, operations, record keeping, quality control- Self assessment or audit

UNIT IV - GUIDANCE FOR OPERATIONAL LEVEL 3A, 3B, 3C (9 Hours)

Guidance for Operational Level 1a, 1b, 2a, and 2b: Staff and Training, facilities, operations, record keeping, quality control- Self assessment or audit

UNIT V - QUALITY CONTROL & RADIOPHARMACOLOGY LOCALIZATION MECHANISMS (9 Hours)

Quality control of radiopharmaceuticals - RP Licensing systems and role of pharmacopoeia - Practical working a RP monograph - Sterility test, pyrogen test - Procurement of radiopharmaceuticals - Infection and inflammation imaging – Radio-labeling of white blood cells (WBC) and red blood cells (RBC).

TEXT BOOKS

1. Anthony Theobold, "*Textbook of Radiopharmacy*"**,** Pharmaceutical Press, Fourth Edition, 2010.
2. Charles B. Sampson, "*Textbook of Radiopharmacy: Theory and Practice*", Gordon and Breach Science Publishers, Third Edition, 1999.

REFERENCES

1. *"Competency Based Hospital Radiopharmacy Training"*, International Atomic Energy Agency, Vienna, 2010.
2. *"Operational Guidance on Hospital Radiopharmacy: A Safe and Effective approach"*, International Atomic Energy Agency, Vienna, 2008.
3. Ellis B L, Sampson C B. "*Radiolabelling of blood cells – Theory and Practice",* Gordon and Breach Science Publishers, Third Edition, 1999.

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III. BIOMEDICAL ENTREPRENEUR

BM1113	**REGULATORY ASPECTS IN BIOSCIENCES**	**L**	**T**	**P**	**C**
	Total contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE	
To provide the ability to gain knowledge of different regulatory aspects in biosciences	
INSTRUCTIONAL OBJECTIVES	
1.	To make them understand the regulations of Food and Drug Administration
2.	To impart the knowledge about Legal issues and Health policies related to Biosciences.
3.	To gain in-depth knowledge about the Ethical and Regulatory Guidance
4.	To make the students understand the active control trials in the evaluation of new treatments

UNIT I - INDIVIDUAL AND INSTITUTIONAL RESPONSIBILITY & REGULATION BY FDA (9 Hours)

Researching a bioethical question, Individual and institutional responsibility, Institutional review boards, Role of independent institutional review boards, The regulation of drugs and biological products by the food and drug administration.

UNIT II - LEGAL ISSUES AND HEALTH POLICY (9 Hours)

Data and safety monitoring, Legal issues and rules to prevent conflict of interest on human subjects, National institutes of health policy on the Inclusion of women and minorities as subjects, Role and importance of trial registries and results databases.

UNIT III - ETHICAL AND REGULATORY GUIDANCE (9 Hours)

Immobilization, The Nurenberg code, Declaration of Helsinki: Ethical principles of medical research involving human subjects, The Belmont report: Ethical principles and guidelines for the protection of human subjects, The common rule, Code of federal regulations.

UNIT IV - DISTINCTION BETWEEN RESEARCH AND TREATMENT & THE ETHICS OF RANDOMIZED CLINICAL TRIALS (9 Hours)

Research and Practice, Demarcating Research and Treatment: A Systematic Approach, The ethics of randomized clinical trials: Problems of the randomized clinical trial, Equipoise and the ethics of clinical research, Randomized controlled trials: Lessons from ECMO.

UNIT V - ROLE OF PLACEBOS IN CLINICAL RESEARCH & CHANGING LANDSCAPE OF HUMAN EXPERIMENTATION (9 Hours)

The continuing unethical use of placebo controls, Placebo-controlled trials and the logic of clinical purpose, Active control trials in the evaluation of new treatments, The changing landscape of human experimentation.

TEXT BOOKS

1. John I. Gallin, Frederick P. Ognibene "*Principles and Practice of Clinical Research"*, Academic Press, Third Edition, 2012.
2. Ezekiel J. Emanuel, Robert A. Crouch, John D. Arras, Jonathan D.Moreno, Christine Grady, "*Ethical and Regulatory Aspects of Clinical Research*", Johns Hopkins University Press, First Edition, 2003.

REFERENCES

1. Michael A. Santoro, Thomas M. Gorrie, *"Ethics and the Pharmaceutical Industry",* Cambridge University Press, First Edition, 2005.
2. Susan E Lederer, *"Subjected To Science*: *Human Experimentation in America before the Second World War*", Johns Hopkins University Press, First Edition, 1995.

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BM1114	HOME MEDICARE TECHNOLOGY	L	T	P	C
	Total contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To provide the basics of home Medicare and its clinical applications in recent telehealth technology.

INSTRUCTIONAL OBJECTIVES

1.	To make them understand about basics of home Medicare system
2.	To impart the knowledge about the Home Medicare in various clinical application
3.	To gain knowledge in design of home care devices
4.	To understand the various aspects that influence safety, quality and effective home medicare
5.	To gain in-depth knowledge about the advances in healthcare technologies and wireless technology related to healthcare system

UNIT I - INTRODUCTION TO HOME MEDICARE (9Hours)

Home health care – purpose – legal and ethical aspects- Organisation of home care system- Historical development of home care- Environmental influences on home care-Home care organisation- Home care nursing practice-Role of home care nurse and orientation strategies- Infection control in home -Patient education in home.

UNIT II - WORKING WITH CLIENTS (9Hours)

Basic human needs – communication and interpersonal skills – caregiver observation, recording and reporting, confidentiality. Working with elderly – aging and body systems. Working with children – need for home care. Mobility – transfers and ambulation, range of motion exercises, skin care and comfort measures.

UNIT III – MEDICAL DEVICES AT HOME (9Hours)

Medical devices at home – User centered design and Implementation – Co-design with old users – device types – user issues. Ethical and legal issues. Infant monitors, medical alert services, activity monitors.

UNIT IV - ADVANCEMENT IN MEDICAL TECHNOLOGIES (9Hours)

Advances and trends in health care technologies-Driver impacting the growth of medical Technologies- Impact of Moore"s law of medical imaging- E-health and personal healthcare- Defining the future of health Technology- Inventing the future -

tools for self health- Future of nano fabrication molecular scale devices- Future of telemedicine -Future of medical computing.

UNIT V - WIRELESS TECHNOLOGY (9Hours)

Wireless communication basics- Types of wireless network, Body area network- Emergency rescue- Remote recovery- General health assessments Technology in medical information processing- Future trends in healthcare technology.

TEXT BOOKS

1. Robyn Rice, "*Home care nursing practice: Concepts and Application"*, 4th edition, Elsevier, 2006.
2. LodewijkBos, *"Handbook of Digital Homecare: Successes and Failures"*, Springer, 2011.

REFERENCES

1. Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph D. Bronzino,*"Clinical Engineering"*, CRC Press, 2010.
2. Kenneth J. Turner, "*Advances in Home Care Technologies: Results of the match Project",* Springer, 2011.

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BM1115	**DESIGN AND DEVELOPMENT OF MEDICAL DEVICES**	**L**	**T**	**P**	**C**
	Total contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Basic knowledge of various medical equipments, sensor, and amplifier				

PURPOSE

This course will introduce students with basics of design, construction and development process of devices which are used in medical, clinical or laboratory practice.

INSTRUCTIONAL OBJECTIVES

1.	To understand about basic design of medical device.
2.	To study in detail about data acquisition system used in medical device
3.	To study the minimally invasive device and technique used in medical devices
4.	To study in detail about system description of diagnostic equipment.
5.	To study in detail about system description of therapeutic equipments and various implants

UNIT I - INTRODUCTION TO MEDICAL DEVICE (9 Hours)

Medical devices- Clinical needs-medical devices vs medical instruments-data acquisition systems-medical electrical stimulator-cardiac electrical conduction-standard leads-clinical needs-system description and diagram.

UNIT II - PACEMAKERS AND EXTERNAL DEFIBRILLATORS (9 Hours)

Two arrhythmia classes- heart failure-tissue response to stimulation voltage-system description and diagram-temporary cardiac pacing-tachyarrhythmia's-cardiac arrest-cardiopulmonary resuscitation-defibrillation mechanism and threshold-system description and diagram.

UNIT III - HEART VALVES AND FUNCTIONAL ELECTRICAL STIMULATOR (9 Hours)

Cardiac mechanisms-blood coagulations-clinical needs-system description and diagram-spinal nerves-electrical stimulation-system description and diagram-emerging technologies.

UNIT IV - INTRAOCULAR LENS IMPLANTS AND TOTAL HIP PROSTHESES (9 Hours)

Ocular physiology-ultrasound-clinical needs-system description and diagram- hip physiology-wear mediated osteolysis-clinical needs-system description and diagram

UNIT V - ARTIFICIAL PANCREAS (9 Hours)

Blood glucose regulation-compartment models-clinical needs-artificial pancreas requirements-system description and diagram

TEXT BOOKS

1. Gail Baura, "*Medical Device Technologies: A Systems Based Overview Using Engineering*", Elsevier science, 2002
2. Martin Culjat, Rahul Singh, Hua Lee, *"Medical Devices: Surgical and Image-Guided Technologies*", John Wiley & Sons, Reinaldo perez, "*Design of medical electronic device*", Elsevier science, 2002.
3. Richard C. Fries, "*Handbook of Medical Device Design*", Marcel Dekker AG, 2nd edition 2005.

REFERENCES

1. Anthony Y. K. Chan, "*Biomedical device technology: principles and design*", Charles C Thomas, 2008.
2. Theodore R. Kucklick, "*The Medical Device Ramp-D Handbook*", Taylor &Francis Group LLC, 3rd edition 2013.
3. David Prutchi, Michael Norris, *"Design and Development of Medical Electronic Instrumentation: A Practical perspective of the design, construction and test of medical devices*", John Wiley & Sons, 2005.

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IV. RESEARCH AND DEVELOPMENT ENGINEER

BM1116	**APPLIED OPTOELECTRONICS IN MEDICINE**	**L**	**T**	**P**	**C**
	Total contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

To get familiar with the different types of optical emission, detection, modulation and opto electronic integrated circuits and their applications

INSTRUCTIONAL OBJECTIVES

1.	To know the basics of solid state physics and understand the nature and characteristics of light
2.	To understand different light modulation techniques and the concepts and applications of optical switching
3.	To study the integration process and application of opto electronic integrated circuits in transmitters and receivers

UNIT I - LIGHT SOURCES (9 Hours)

Photo Luminescence, Cathode Luminescence, Electro Luminescence, Injection Luminescence, LED, Laser Emission, Absorption, Population Inversion, Threshold condition, Optical Feedback, Laser Modes, Classes of Lasers, Pulsed Lasers

UNIT II - OPTO-ELECTRONIC DETECTION METHODS (9 Hours)

Basic principles of opto-electronic detection, Types of Photodiodes, Thermal detector, Photo Devices, Photo conductors, Photo detectors, Detector performance, Noise considerations

UNIT III - OPTOELECTRONIC MODULATOR (9 Hours)

Basic principles, Analog and digital modulation, Electro-optic modulators, Magneto optic devices, Acousto-optic devices, Optical switching, Logic devices-optical switching,

UNIT IV - OPTICAL AMPLIFIER & OPTOELECTRONIC INTEGRATED CIRCUITS (9 Hours)

Semiconductor optical amplifier, Erbium doped fiber amplifier, Fiber Raman amplifier, Hybrid integration, Monolithic integration, Integrated transmitters and Receivers, Guided wave devices, Principles of optical biosensors, Application of opto-electronic integrated circuits

UNIT V - DISPLAY DEVICES AND APPLICATIONS OF OPTOELECTRONIC DEVICES **(9 Hours)**

Plasma display, LCD display, Numeric display, Cardiovascular and intensive care sensors, FBG for strain and temperature measurement

TEXT BOOKS

1. Wilson J and Hawkes J.F.B, *"Opto Electronics – An Introduction*", second edition, Prentice Hall of India Pvt. Ltd., New Delhi, 1998.
2. Safa.O.Kasap, *Optoelectronics and Photonics: Principles and practices*, first edition,PHI, 2009

REFERENCES

1. Bhattacharya "*Semiconductor Opto Electronic Devices",* second edition, Prentice Hall of India Pvt., Ltd., New Delhi, 1997.
2. Jasprit Singh, "*Opto Electronics – As Introduction to materials and devices*",first edition, McGraw-Hill International Edition, 1996.

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	BIOMEDICAL MEMS AND NANOTECHNOLOGY	L	T	P	C
BM1117	Total contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

To enable the students to acquire knowledge about the principles & application of MEMS &Nanotechnology in biomedical industry

INSTRUCTIONAL OBJECTIVES

To enable the students

1.	To understand the working principle of MEMS & Microsystems
2.	To understand the working of MOEMS Technology
3.	To understand the concepts of BioMEMS& its application in healthcare
4.	To understand the concepts of BioMEMS& its application in healthcare
5.	To study about the biomedical Nanotechnology & its application in research domain

UNIT I - MEMS & MICROSYSTEM (8 Hours)

MEMS and Microsystems- Introduction - Typical MEMS and Microsystem Products - Application of Micro-system in Healthcare Industry – Working Principles of Microsystems Micro-sensors – Micro-actuation -MEMS with Microactuation– Micro-accelerators

UNIT II - MICRO-OPTO ELECTROMECHANICAL SYSTEMS (MOEMS) (9 Hours)

Fundamental principle of MOEMS Technology, Advantages - Light Modulators, Beam splitter – Micro-lens, Micro-mirrors - Digital Micro-mirror Device, Grating Light Valve, Optical Switch, Waveguide and Tuning

UNIT III – MICROFLUIDIC SYSTEMS (10 Hours)

Microfluidics- Introduction and Fluid Properties, Applications of MFS- Fluid Actuation Methods- Electrophoresis, Dielectrophoresis, Electrowetting, Optoelectrowetting, Electroosmosis Flow, Electrothermal Flow, Thermocapillary Effect- Microfluidic Channel- Microdispenser- Microneedle- Microfilter

UNIT IV – BIOMEMS (9 Hours)

Introduction to BioMEMS, BioMEMS for Clinical Monitoring, Lab on a chip, DNA Sensors, E-Nose, E-Tongue, Microsystem approaches to PCR, MEMS based Implantable Drug Delivery System, Emerging BioMEMS Technology.

UNIT V - BIOMEDICAL NANOTECHNOLOGY (9 Hours)

Introduction to nanoscale phenomena, Nanoparticles- Nanomaterial characterization – XRD, SAXS, TEM, SEM, Scanning Tunneling microscopy, AFM, SPM technique, Biomolecular sensing for cancer diagnostics using carbon nanotubes, Carbon nanotube biosensors, Magnetic nanoparticles for MR Imaging, Nano-devices in biomedical applications.

TEXT BOOKS

1. Tai-Ran Hsu, "*MEMS & Microsystems- Design, Manufacture and Nanoscale Engineering"*, John Wiley & Sons, 2nd Edition 2008
2. Nitaigour Premchand Mahalik, "*MEMS*", Tata McGraw Hill, 2nd Reprint 2008
3. Wanjun Wang & Steven A.Soper , "*BioMEMS- Technologies and applications*", CRC Press, First edition 2007

REFERENCES

1. Steven S. Saliterman, "*Fundamentals of BioMEMS & Medical Microdevices",* International Society for Optical Engineering, First Edition 2006
2. Gerald A Urban, "*BioMEMS",* Springer, First Edition 2006
3. Abraham P. Lee and James L. Lee, "*BioMEMS and Biomedical Nanotechnology*", Volume I, Springer, First Edition 2006.
4. Paul C.H. Li, "*Introduction to Microfluids and BioMEMS: A Design and Problem-Solving Textbook*", CRC Press, First Edition 2009
5. Hari Singh Nalwa, "*Nanostructured Materials and Nanotechnology*", Academic Press, First Edition 2002
6. Guozhong Cao & Ying Wang, "*Nanostructures and Nanomaterials- Synthesis, Properties and Applications",* World Scientific, 2nd Edition 2011.

BM1117 BIOMEDICAL MEMS AND NANOTECHNOLOGY												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
					X					**X**		
2	Mapping of instructional objectives with student outcome				**3**					**5**		
3	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)	
											x	

4	Broad area (for "P"category)	Biomedical Electronics Engg	Basics of biomedical Engg	Biomedical Instrument ation Engg	Biomedical Imaging Engg	Health care Engg
				X		
5	Approval	23rd meeting of Academic Council, May 2013				

BM1118	**APPLIED NEURAL NETWORKS AND FUZZY LOGIC IN MEDICINE**	**L**	**T**	**P**	**C**
	Total contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

To learn the basic concepts of Neural Networks & Fuzzy Logic and learn to design and use them for biomedical applications

INSTRUCTIONAL OBJECTIVES

1.	To understand the basic concepts of artificial neural networks
2.	To study the various ANN Models
3	To familiarize about the Self organizing maps and competitive networks
4	To study the basic concepts of fuzzy Logic systems
5	To apply the concepts of ANN and Fuzzy Logic in Biomedical applications

UNIT I - ARTIFICIAL NEURAL NETWORKS-AN OVERVIEW (9 Hours)

Neural Networks Basics-Biological Neural nets, Processing elements-Mc Culloh Pitts Model, Types of Learning, Network Parameters-Weights, Activation, Threshold Functions, Hebb Rule, Delta Rule, Perception learning Algorithm

UNIT II - ANN MODELS (9 Hours)

Mapping, training of Feed forward networks-Perception, Mapping, training of Recurrent Networks-Hopfield Network, Radial Basis Function Network, Training of Feed Forward Back Propagation Network, Applications of BPN

UNIT III - SELF ORGANIZING MAPS (SOM) (9 Hours)

Self organizing maps-Pattern clustering, SOM-Topological Mapping, Kohonen"s SOM, K-means clustering algorithm, competitive models-Min, Max Net, Adaptive Resonance Theory (ART)-Introduction, Network and Processing in ART, Associative memory model

UNIT IV - INTRODUCTION TO FUZZY LOGIC (9 Hours)

Fuzzy logic-Basic concepts -Fuzzy Vs Crisp set, Linguistic variables, Membership functions, Fuzzy IF-THEN rules, Variable inference techniques, De-fuzzification techniques, Basic fuzzy inference algorithm.

UNIT V - NEURAL NETWORK AND FUZZY LOGIC APPLICATIONS IN MEDICINE (9 Hours)

Neural Networks in Biomedical Applications, Cancer, Cardiovascular Applications, Medical Image Analysis using neural networks, Fuzzy Logic Applications, Fuzzy Logic Controller, Neuro fuzzy systems- Applications in medicine

TEXT BOOKS

1. Mohamad H. Hassoun, "*Fundamentals of Artificial Neural Network*", Cambridge, The MIT Press, First edition, 1995.
2. Laurene Fausett, "*Fundamentals of Neural Networks: Architectures, Algorithms, and Applications",* Pearson Education India, Third edition, 2008.

REFERENCES

1. C.M.Bishop, "*Pattern Recognition and Machine Learning",* Springer-Verlag, 2006
2. Timothy J. Ross, "*Fuzzy Logic with Engineering Applications",* John Wiley and Sons, Second edition,1995
3. B.Yegnanarayana, "*Artificial Neural Networks*", Prentice Hall of India, Third edition 2006

BM1118 APPLIED NEURAL NETWORKS AND FUZZY LOGIC IN MEDICINE												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		X	**X**									
2	Mapping of instructional objectives with student outcome	**1**	**2**									
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)			
									X			

4	Broad area (for "P"category)	Biomedical Electronics Engg	Basics of biomedical Engg	Biomedical Instrumentation Engg	Biomedical Imaging Engg	Health care Engg
					X	
5	Approval	23rd meeting of Academic Council, May 2013				

		L	T	P	C
BM1119	**ARTIFICIAL INTELLIGENCE AND PATTERN RECOGNITION IN MEDICINE**				
	Total contact Hours 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

To enable the students to acquire knowledge about the artificial intelligence techniques and to recognize the patterns and its application in medicine

INSTRUCTIONAL OBJECTIVES

1.	To understand the basic concepts of Artificial intelligence structures and strategies
2.	To understand the concepts of knowledge representation in AI
3.	To study the different pattern recognition techniques and feature extraction based on clustering
4.	To give an insight knowledge about the different types of classification techniques
5.	To study about the application of AI in medical field

UNIT I - ARTIFICIAL INTELLIGENCE (9 Hours)

Artificial Intelligence (AI): Introduction, definition & history, Components, Problem definition- Structures and Strategies for state space search- Depth first and breadth first search- DFS with iterative deepening- Heuristic Search- Best First Search- A* Algorithm- AND, OR Graphs, Problems.

UNIT II - KNOWLEDGE REPRESENTATION IN AI (9 Hours)

Propositional- and Predicate- calculus, Theorem proving by resolution, AI representational schemes- Semantic nets, Conceptual graphs: Using frames and scripts- Production system, Rule based expert system

UNIT III - PATTERN RECOGNITION (9 Hours)

Classes, patterns & features- Pattern similarity and PR Tasks- Pattern discrimination- Feature space metrics & Covariance matrix- Feature assessment- Unsupervised learning, Statistical, syntactic and descriptive approaches

UNIT IV - CLASSIFICATION **(9 Hours)**

Linear discriminants, Bayesian classification, Bayes rule for minimum risk, minimum error rate classification, discriminant functions, and decision surfaces, Model free technique – ROC Curve, Classifier evaluation, Back propagation learning, Competitive learning, K-means clustering

UNIT V - APPLICATIONS IN MEDICINE **(9 Hours)**

Diagnosis of disease using AI, Biometrics: Face recognition and Gene matching- Automated drug delivery systems- Computer aided diagnosis- Mining of electronic health record- Computer vision

TEXT BOOK

1. George.F.Luger, "*Artificial Intelligence- Structures and Strategies for Complex Problem Solving*", 4/e, 2002, Pearson Education.
2. Duda and Hart P.E, "*Pattern classification and scene analysis*", John wiley and sons, NY, 1973.

REFERENCES

1. Earl Gose, Richard Johnsonbaugh, and Steve Jost; "*Pattern Recognition and Image Analysis*", PHI Pvte. Ltd., NewDelhi-1, 1999.
2. Fu K.S.*, "Syntactic Pattern recognition and applications"*, Prentice Hall, Eaglewood cliffs, N.J., 1982
3. Rochard O. Duda and Hart P.E, and David G Stork, "*Pattern classification*", 2nd Edn., John Wiley & Sons Inc., 2001.
4. Carlo Combi, Yuval Shahar; "*Artificial Intelligence in Medicine*" – 12th Conference – Springer.

BM1119 ARTIFICIAL INTELLIGENCE AND PATTERN RECOGNITION												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		X	**X**		**X**							
2	Mapping of instructional objectives with student outcome	**1**	**2**		**5**							
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)		
										x		

4	Broad area (for "P"category)	Biomedical Electronics Engg	Basics of biomedical Engg	Biomedical Instrument ation Engg	Biomedical Imaging Engg	Health care Engg
					X	
5	Approval	23rd meeting of Academic Council, May 2013				

BM1120	**BRAIN COMPUTER INTERFACE**	**L**	**T**	**P**	**C**
	Total contact Hours 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Basic knowledge of bio signals and neural networks				

PURPOSE

To understand the biophysical basis of non-invasive brain signals, to apply signal processing, discrimination, and classification tools to interpret these signals, and to implement these tools into a control system for a brain-computer interface.

INSTRUCTIONAL OBJECTIVES

1.	To study the hardware and software components of BCI
2.	To familiarize the concepts of the classifiers for BCI
3.	To understand the feature extraction methods for classifying BCI
4.	To gain knowledge in BCI based on visually evoked potentials
5.	To study the analysis of visuo-motor tasks in a BCI

UNIT I - HARDWARE/SOFTWARE COMPONENTS OF BCI (9 Hours)

Introduction, Components and signals, Electrodes, Bio signal amplifier, Real-time processing environment, Motor imagery, P300 spelling device, SSVEP, Accuracies achieved with different BCI principles, Applications-twitter, second life, smart home control with BCI

UNIT II - APPLIED ADVANCED CLASSIFIERS FOR BCI (9 Hours)

Introduction, Signal processing and feature selection, Flow of the online and offline activities, Windowing, FFT, Statistical analysis procedure, Reduction of the feature space dimensionality, Neural network Classifier for BCI devices , Experimental procedures-ANN, SVM.

UNIT III - FEATURE EXTRACTION METHODS IN CLASSIFYING EEG SIGNAL FOR BCI (9 Hours)

Introduction-Methods, Mutual information, Min max mutual information, Experimental setup, Data set, Results, P300-based BCI Paradigm Design- Event-Related Potentials (ERPs), P300 detection, Applications of P300.

UNIT IV - BCI BASED ON THE FLASH ONSET AND OFFSET VEP (9 Hours)

Introduction- Methods- Peak-to-valley amplitudes in the onset and offset FVEPs, Determination of gazed target, Usability of Transient VEPs in BCIs- VEPs, Availability of transient VEPs, Machine learning approach

UNIT V - VISUO-MOTOR TASKS IN A BCI ANALYSIS (9 Hours)

Introduction-Visuo motor tasks, Subjects and EEG sessions-Signal processing and fuzzy estimator, Advances in Non-Invasive BCI for Control and Biometry-Beam forming BCI,

EEG based biometry

TEXT BOOKS

1. Reza Fazel-Rezai, "*Recent Advances in Brain-Computer Interface Systems"*, Intech Publications, First Edition,2011
2. Theodre W.Berger, John k.Chapin et all, "*Brain computer interfaces, An International assessment of research and developmental trends"*, Springer,First Edition,2008

REFERENCES

1. Guido Dornhege, "*Toward brain-computer interfacing"*, MIT Press, First Edition,2007

BM1120 BRAIN COMPUTER INTERFACE												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		X	**X**									**X**
2	Mapping of instructional objectives with student outcome	**1**	**5**									**3**
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)		
										x		
4	Broad area (for "P"category)	Biomedical Electronics Engg		Basics of biomedical Engg		Biomedical Instrumentation Engg		Biomedical Imaging Engg		Health care Engg		
						X						
5	Approval	23rd meeting of Academic Council, May 2013										

BM1121	ELECTROPHYSIOLOGY FOR HUMAN SYSTEM	L	T	P	C
	Total contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

The purpose of the course is to understand the concepts and methods of electrical bio physics in the diagnosis and treatment of human diseases.

INSTRUCTIONAL OBJECTIVES

1.	To understand the basics of the cell physiology
2.	To study about the electro cardiology
3	To perform the electrical activity of the muscles physiology
4	To understand the function and nerve conduction
5	To study about the peripheral nervous system

UNIT I - INTRODUCTION TO CELL PHYSIOLOGY (10 hours)

Level of organizing the body-chemical level, cellular level, organ level, organism level-Concept of membrane potential-Membrane potential. Electrical field in cells and Organism-Electrical structure of the living organism-extracellular field and currents-passive –action potential-electrical tissue and cell suspension-single cell in external electrical field-manipulation of cell by electric field.

UNIT II - ELECTRICAL CARDIAC PHYSIOLOGY (9 hours)

Electrical activity of the heart-cardio auto rhythmic the action potential of contractile cell-ECG record different part of the ECG record, ECG diagnosis the abnormal events-Mechanical events of the cardiac cycle-Cardiac output its control.

UNIT III - ELECTRICAL MUSCLE PHYSIOLOGY (9 hours)

Molecular basis of the skeletal muscle contraction-Skeletal muscle fibred, myosin forms thick filaments-Muscle mechanics- Group of muscle fiber, types of contraction, EMG motor unit: EMG conduction motor unit, Muscle motor unit recruitment, Muscles fiber frequency of stimulation- Types of muscles based on the ATP hydrolysis and synthesis.

UNIT IV – INVASIVE ELECTROPHYSIOLOGY (9 hours)

Baseline Assessment, Calculations (BPM to Cycle Length), Interval Measurements - Methods of Recording and Evaluation -Electrogram recognition - Assessment of conduction system -Determination of refractory period --Stimulation Protocols - ECG Morphology during Intracardiac Pacing- Evaluation of Arrhythmia-Supraventricular tachycardia -Ventricular tachycardia - Response to stimulation - Response to drug studies

UNIT V – CLINICAL ELECTROPHYSIOLOGY (8 hours)

Initial Assessment-Diagnostic workup, Clinical Evaluation of Arrhythmia -Response to drugs-Response to vagal maneuvers - Emergency management, Indications, Contraindications for EP Study

TEXT BOOKS

1. Laura lee Sherwood, "*Human Physiology from cell to system*", eighth edition, 2012
2. Laura lee Sherwood, "*Fundamental of Physiology of Excitable Cells*", 2010.

REFERENCES

1. Lionel Opie, "*Heart Physiology*" 2009
2. Aidley, "*The Physiology of Excitable Cells*", 3rd/4 the edition, 2008 Cambridge Press.
3. Francis D Murgatroyd, Andrew D. Krahn, *Handbook of cardia Electrophysiology, A practical guide to invasive EP studies and catheter Ablation*, Remedica Publishing 1st Edition 2002,
4. Issa miller Zipes, *Clinical Arrhythmology and electrophysiology* Saunders; 2 edition 2012

BM1121 ELECTROPHYSIOLOGY FOR HUMAN SYSTEM												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
					X							
2	Mapping of instructional objectives with student outcome				**1-5**							
3	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)	

						x
4	Broad area (for "P"category)	Biomedical Electronics Engg	Basics of biomedical Engg	Biomedical Instrument ation Engg	Biomedical Imaging Engg	Health care Engg
			X			
5	Approval	23rd meeting of Academic Council, May 2013				

V. HIGHER STUDIES

BM1122	**BIOPHOTONICS**	**L**	**T**	**P**	**C**
	Total contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

To impart adequate knowledge on various optical systems used in sensing and Imaging of biological elements.

INSTRUCTIONAL OBJECTIVES

1.	To educate about the various interaction mechanisms of light with matter.
2.	To make them understand the working principles of optical imaging systems.
3.	To provide an insight to various biosensors
4.	To gain in-depth knowledge about flow cytometer
5.	To enable them to understand the importance of phototherapy in treatment of diseases

UNIT I - LIGHT - MATTER INTERACTION & PRINCIPLE OF OPTICS (9 hours)

Light matter interaction: Interaction of light with bulk matter- Types of spectroscopy: Electronic absorption, Electronic luminescence, Vibration-, and Fluorescence-spectroscopy.

UNIT II- BIO-IMAGING: PRINCIPLES AND TECHNIQUES (9 hours)

Introduction of optical imaging, Types of microscopy: Transmission-, Fluorescence, Scanning- and Multi-photon- microscopy- Advantages and disadvantages of optical imaging- Applications of optical imaging

.

UNIT III- OPTICAL BIOSENSORS (9 hours)

Principles of Optical biosensing, Immobilization of bio-recognition elements, Types of optical biosensor: Fiber optic, Planar waveguide, Evanescent, Interferometric, and Surface plasmon resonance- biosensor– Advantages and disadvantages- Applications

UNIT IV- FLOW CYTOMETRY **(9 hours)**

Flow cytometry: Basis, Components, and Flourochromes- Data manipulation and presentation

UNIT V- PHOTODYNAMIC THERAPY **(9 hours)**

Photodynamic therapy: Mechanism, and light irradiation- Photo-hemotheraphy- PUVA Technique- Applications.

TEXT BOOKS

1. Jurgen Popp, Valery V.Techin, Arthur Chiou, Stefen Heinemann, "*Handbook of Biophotonics Vol 2: Photonics for Health Care"*, John Wiley & Sons, First Edition, 2012.
2. Paras N. Prasad*, "Introduction to Biophotonics"*, John Wiley & Sons, First Edition, 2003.

REFERENCES

1. Harold Sackman, Brian Wilson, Valeri Viktorovich Tuchin, S. Tanev, Harold Sackman "*Advances in Biophotonics"*, IOS Press, 2005
2. Paras N. Prasad, "*Nanophotonics"*, John Wiley & Sons, First Edition, 2004

<table>
<tr><th colspan="14">BM1122 BIOPHOTONICS</th></tr>
<tr><td colspan="2">Course designed by</td><td colspan="12">Department of Biomedical Engineering</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Student outcome</td><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td>g</td><td>h</td><td>i</td><td>j</td><td>k</td></tr>
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<tr><td rowspan="2">4</td><td rowspan="2">Broad area (for "P"category)</td><td colspan="3">Biomedical Electronics Engg</td><td colspan="3">Basics of biomedical Engg</td><td colspan="3">Biomedical Instrumentation Engg</td><td colspan="2">Biomedical Imaging Engg</td><td>Health care Engg</td></tr>
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BM1123	BIOMECHANICS	L	T	P	C
	Total contact Hours - 45	3	0	0	3
	Prerequisite				
	Basic knowledge of human joint movement				

PURPOSE

To provide the knowledge of mechanical concepts as applied to human movement.

INSTRUCTIONAL OBJECTIVES

1.	To study about the bone structure and cartilage
2.	To study the structure and functions of skeletal muscle
3	To study the structure, movements, and loads applied to spine, shoulder and hip.
4	To study about the fluid mechanic system applied to human body
5	To understand the principles of mechanics that is used to analyze human movement.

UNIT I - FUNDAMENTALS OF MECHANICS (9 Hours)

Newton"s law- mechanical behavior of bodies in contact, work, power and energy relationship – Angular kinematics of human movement-measuring angles, angular kinematic relationships –relationships between linear and angular motion – Angular kinetics of human movement-resistance to angular acceleration, angular momentum – Equilibrium and human movement-equilibrium, center of gravity, stability and balance.

UNIT II - BONE AND CARTILAGE (9 Hours)

Bone structure & composition, blood circulation in bone – mechanical properties of bone, viscoelastic properties of bone – Maxwell & Voight models – viscoelastic properties of articular cartilage – Anisotropy and composite models for bone – Bone growth and development – Bone response to stress – Osteoporosis – causes, diagnosis, treatment – Elasticity and strength of bone .

UNIT III - BIOFLUID MECHANICS (9 Hours)

Newtonian viscous fluid, non viscous fluid – Rheological properties of blood – Structure and composition of blood vessel – Remodeling of blood vessels – Nature of fluids, Propulsion in fluid medium – Mechanical properties of arterioles, capillary vessels and veins.

UNIT IV - MECHANICS OF SKELETAL MUSCLE (9 Hours)

Structure of skeletal muscle –muscle fibers, motor units – Structure of skeletal muscle-fiber types, fiber architecture – Sliding element theory of skeletal muscle.- Skeletal muscle function – Contraction of skeletal muscle and hill"s three element

model – Factors affecting muscular force generation – Muscular strength, power and endurance – Muscle injuries .

UNIT V - MECHANICS OF SHOULDER, SPINE AND HIP (9 Hours)

Structure of the shoulder – Movements of shoulder complex – Loads on the shoulder – Structure of the spine – Movements of the spine – Muscles and loads on the spine – Structure and movements of the hip – Loads on the hip.

TEXT BOOKS

1. Y C Fung, Biomechanics: "*Mechanical Properties of Living Tissues*", Springer, 2nd edition, 1993.
2. Susan .J. Hall: "*basic biomechanics*", Tata Mcgraw hill, 4th edition, 2004.

REFERENCES

1. J. G Webster, "*Medical instrumentation –Application & design",* John Wiley and Sons Inc., 3rd edition, 2003.
2. D. J. Schneck and J. D. Bronzino, "*Biomechanics- Principles and Applications"*, CRC Press, 2nd Edition, 2000.
3. Duane Knudson, "*Fundamentals of Biomechanics*", Springer, 2nd edition, 2007

<table>
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<tr><td rowspan="2">1</td><td rowspan="2">Student outcome</td><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td>g</td><td>h</td><td>i</td><td>j</td><td>k</td></tr>
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<tr><td>2</td><td>Mapping of instructional objectives with student outcome</td><td>2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>1</td><td></td><td>3</td></tr>
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<tr><td rowspan="2">4</td><td rowspan="2">Broad area (for "P"category)</td><td colspan="3">Biomedical Electronics Engg</td><td colspan="3">Basics of biomedical Engg</td><td colspan="3">Biomedical Instrumentation Engg</td><td colspan="3">Biomedical Imaging Engg</td><td>Health care Engg</td></tr>
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BM1124	**COMPUTATIONAL FLUID DYNAMICS ANALYSIS IN MEDICINE**	**L**	**T**	**P**	**C**
	Total contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Basic knowledge of fluid mechanics & mathematics (PDE and linear algebra)				

PURPOSE

To enable the students to acquire knowledge about Computational Fluid Dynamics which is useful in analysis & design of various fluid flow medical devices

INSTRUCTIONAL OBJECTIVES

1.	To understand the fundamentals of fluid dynamics
2.	To understand the importance of CFD and numerical methods
3.	To get an insight into FEM, FDM & FVM
4.	To study the fundamentals of discretization
5.	To know about the application of CFD in biomedical domain

UNIT I - BASIC CONCEPTS & FUNDAMENTALS OF FLUID DYNAMICS (9 Hours)

Definition & properties of fluids and classification of fluids, Introduction to fluid statics & kinematics, Governing Equations of fluid motion: Langragian & Eulerian description, Reynolds transport theorem, Integral & differential forms of governing equations: mass, momentum & energy conservation equations, Euler"s Equation, Bernoulli"s Equation, Navier-Stokes equations

UNIT II - INTRODUCTION TO CFD & OVERVIEW OF NUMERICAL METHODS (9 Hours)

Computational fluid dynamics (CFD): What, When & Why, CFD Applications, Classification and Overview of Numerical Methods: Classification into various types of equation; parabolic elliptic and hyperbolic; boundary and initial conditions; Overview of numerical methods, Illustrative examples of elliptic, parabolic and hyperbolic equations.

UNIT III - INTRODUCTION TO FEM, FDM & FVM (9 Hours)

Finite element method (FEM) - Finite difference method (FDM)- Finite volume method (FVM) – Its application in medicine.

UNIT IV - FUNDAMENTALS OF DISCRETIZATION (9 Hours)

Discretization principles: Pre-processing, Solution, Post-processing, Finite Element Method, Finite difference method, Well posed boundary value problem, Possible types of boundary conditions, Conservativeness, Boundedness, Transportiveness,

Finite volume method (FVM), Illustrative examples: 1-D steady state heat conduction without and with constant source term, Comparison of Discretization techniques.

UNIT V - CFD IN MEDICINE **(9 Hours)**

Examples of Biomedical CFD applications, Case Study-1: Respiratory flow in a bifurcation- Case Study-2: CFD Analysis of blood pump - Case Study-3: Computational model of blood flow in the aorta-coronary bypass graft.

TEXT BOOKS

1. Robert W. Fox, Philip J. Pritchard, Alan T McDonald, "*Introduction to Fluid Mechanics*", John Wiley & Sons, Seventh Edition 2009.
2. Frank M. White, "*Fluid Mechanics*", Tata McGraw-Hill, Singapore, Sixth Edition, 2008
3. Goldstein J. Richard, "*Fluid Mechanics Measurements*", Taylor & Francis Publication, Second Edition 1996

REFERENCES

1. Chung T.J, "*Computational Fluid Dynamics",* Cambridge University Press, 2nd Edition 2010
2. John D. Anderson, Jr, "*Computational Fluid Dynamics The Basics with Applications",* Tata Mcgraw Hill, First Edition 2012
3. Blazek J, "*Computational Fluid Dynamics: Principles & Applications",* Elsevier, 1st Edition 2001
4. Ferziger J.H, & Peric M, "*Computational Methods for Fluid Dynamics", Springer,* 3rd Edition 2002
5. Versteeg H.k & Malalasekara W, *"Introduction to Computational Fluid Dynamics: The Finite Volume Method",* Pearson Education, 2nd Edition 2008
6. Shaw C.T, "*Using Computational Fluid Dynamics",* Prentice Hall, First Edition 1992

BM1124 COMPUTATIONAL FLUID DYNAMICS ANALYSIS IN MEDICINE												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		X		**X**		**X**						
2	Mapping of instructional objectives with student outcome	**1**		**5**		**5**						

3	Category	General (G)	Basic Sciences (B)	Engineering Sciences and Technical Arts (E)		Professional Subjects (P)
						x
4	Broad area (for "P"category)	Biomedical Electronics Engg	Basics of biomedical Engg	Biomedical Instrument ation Engg	Biomedical Imaging Engg	Health care Engg
					X	
5	Approval	23rd meeting of Academic Council, May 2013				

BM1125	**PHYSIOLOGICAL MODELING**	**L**	**T**	**P**	**C**
	Total contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

To understand and gain knowledge about methods of finding solutions to biological problems using computational tools.

INSTRUCTIONAL OBJECTIVES

1.	To understand the process of modeling to various physiological systems.
2.	To study the mathematical tools for analyzing the model.
3.	To perform time domain and frequency domain analysis of the physiological models
4.	To impart knowledge on simulation techniques for analyzing the systems.
5.	To provide an in-depth knowledge on modeling of physiological system

UNIT I - INTRODUCTION TO PHYSIOLOGICAL CONTROL SYSTEMS (9 Hours)

Introduction to Physiological control systems, Examples – Art of modeling – Linear systems – Mathematical Modeling, System properties- Resistance, Compliance – Models with combination of elements – Muscle model– Linear physiological models – Distributed versus lumped parameter models – Mathematical tools for representation of physiological systems – SIMULINK model of physiological systems

UNIT II - STATIC ANALYSIS (9 Hours)

Static Analysis, Open loop versus closed loop physiological systems – Determination of Steady state operating point – Open loop and closed loop analysis of cardiac model – Determination of steady state operating point of cardiac model – Regulation of glucose insulin model – Chemical regulation of ventilation –Steady state analysis using SIMULINK

UNIT III - TIME DOMAIN ANALYSIS (9 Hours)

Time domain analysis – Introduction to first order and second order model – Respiratory mechanics – open loop and closed loop model of lung mechanics – First order model – impulse and step response – Second order model – Impulse response – undamped, under damped, critically damped, and over damped behavior – Method of obtaining step response from impulse response – Transient response descriptors – Model of neuromuscular reflex motion – Transient response analysis using MATLAB

UNIT IV - FREQUENCY ANALYSIS (9 Hours)

Frequency response analysis – response to sinusoidal inputs – Closed loop and open loop response – Relationship between transient and frequency response – Graphical representation of Frequency response – Bode plot – Nicholas chart – Nyquist plots – Pupillary Retinal system – Frequency response analysis using MATLAB – Simulink

UNIT V - MODELING (9 Hours)

Identification of physiological control systems – Parametric and non-parametric identification methods – Identification of closed loop systems – minimal model of blood glucose regulation – Model based approaches – Neural network for control systems - Introduction – Supervised and direct inverse control – Human thermal system model – Pharmacokinetic modeling

TEXT BOOKS

1. Michael C.K. Khoo, *"Physiological Control Systems – Analysis, Simulation and Estimation*", Prentice Hall of India Private Ltd., New Delhi, 2001.
2. Joseph D Bronzino, "*The Biomedical Engineering Handbook*", CRC Press, 3rdedition, 2006

REFERENCES

1. Claudio Cobelli, Ewart Carson, "*Introduction to Modeling in Physiology and Medicine"*, Academic Press, 2008.

BM1125 PHYSIOLOGICAL MODELING												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		1	**2**		**4**							
2	Mapping of instructional objectives with student outcome	**X**	**X**		**X**							

3	Category	General (G)	Basic Sciences (B)	Engineering Sciences and Technical Arts (E)		Professional Subjects (P)
						x
4	Broad area (for "P"category)	Biomedical Electronics Engg	Basics of biomedical Engg	Biomedical Instrumentation Engg	Biomedical Imaging Engg	Health care Engg
				X		
5	Approval	23rd meeting of Academic Council, May 2013				

BM1126	**ROBOTICS AND AUTOMATION IN MEDICINE**	**L**	**T**	**P**	**C**
	Total contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

To provide the basic knowledge on design, analysis, control and working principle of robotics in surgery, rehabilitation and drug delivery (Nano robot).

INSTRUCTIONAL OBJECTIVES

1.	To study about the basic concepts of robots and types of robots.
2.	To study about manipulators, actuators and grippers.
3.	To study about various types of sensors and power sources
4.	To study the various applications of robot in the medical field.

UNIT I - INTRODUCTION OF ROBOTICS (9 Hours)

Introduction to Robotics and its history, Overview of robot subsystems, Degrees of freedom, configurations and concept of workspace, Automation, Mechanisms and movements, Dynamic stabilization- Applications of robotics in medicine

UNIT II - ACTUATORS AND GRIPPERS (9 Hours)

Pneumatic and hydraulic actuators, Stepper motor control circuits, End effectors, Various types of Grippers, Design consideration in vacuum and other methods of gripping, PD and PID feedback actuator models,

UNIT III - MANUPULATORS & BASIC KINEMATICS (9 Hours)

Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and pneumatic manipulator, Forward Kinematic Problems, Inverse Kinematic Problems, Solutions of Inverse Kinematic problems

UNIT IV - POWER SOURCES AND SENSORS (9 Hours)

Sensors and controllers, Internal and external sensors, position, velocity and acceleration sensors, Proximity sensors, force sensors, laser range finder, variable speed arrangements, Path determination - Machinery vision, Ranging – Laser-Acoustic, Magnetic fiber optic and Tactile sensor

UNIT V - ROBOTICS IN MEDICINE (9 Hours)

Da Vinci Surgical System, Image guided robotic systems for focal ultrasound based surgical applications, System concept for robotic Tele-surgical system for off-pump CABG surgery, Urologic applications, Cardiac surgery, Neuro-surgery, Pediatric-, and General- Surgery, Gynecologic Surgery, General Surgery and Nano robotics.

TEXT BOOKS

1. Nagrath and Mittal, "*Robotics and Control*", Tata McGraw-Hill, First edition, 2003.
2. Spong and Vidhyasagar, "*Robot Dynamics and Control*", John Wiley and Sons, First edition, 2008.
3. Fu. K.S, Gonzalez, R.C., Lee, C.S.G, "*Robotics, control"*, sensing, Vision and Intelligence, Tata McGraw Hill International, First edition, 2008.

REFERENCES

1. Howie Choset, Kevin Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki and Sebastian Thurn, "*Principles of Robot Motion: Theory, Algorithms, and Implementations*", Prentice Hall of India, First edition, 2005.
2. Philippe Coiffet, Michel Chirouze, "*An Introduction to Robot Technology*", Tata McGraw-Hill, First Edition, 1983.
3. Jacob Rosen, Blake Hannaford & Richard M Satava, "*Surgical Robotics: System Applications & Visions*", Springer 2011.
4. http://www.lapsurg.com.br/arquivos/books/medical_robotics12402am020100000000.pdf
5. Barbara Webb and Thomas R Consi, "*BioRobotics: Methods & Applications*", Barbara Webb and Thomas R Consi, AAAI Press/MIT Press, First Edition, 2001.
6. Constantinos Mavroidis, Antoine Ferreira, "Nanorobotics: Current approaches and Techniques" , Springer 2011.

BM1126 ROBOTICS AND AUTOMATION IN MEDICINE												
Course designed by		**Department of Biomedical Engineering**										
1	Student outcome	a	b	c	d	e	f	g	h	i	j	k
				X								**X**
2	Mapping of instructional objectives with student outcome			**3**								**4**
3	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)		
										x		
4	Broad area (for "P"category)	Biomedical Electronics Engg		Basics of biomedical Engg		Biomedical Instrumentation Engg		Biomedical Imaging Engg		Health care Engg		
						X						
5	Approval	23rd meeting of Academic Council, May 2013										