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Curriculum – 2018 Regulation

		I SEMESTER					
S.NO.	SUBJECT CODE	SUBJECT NAME	Ty/ Lb/ ETL	L	T/ SLr	P/R	C
1	BEN18001	Technical English - I	Ty	1	0/0	2/0	2
2	BMA18001	Mathematics - I	Ty	3	1/0	0/0	4
3	BPH18001	Engineering Physics - I	Ty	2	0/1	0/0	3
4	BCH18001	Engineering Chemistry - I	Ty	2	0/1	0/0	3
5	BES18001	Basic Electrical and Electronics Engineering	Ty	2	0/1	0/0	3
6	BES18002	Basic Mechanical and Civil Engineering	Ty	2	0/1	0/0	3
		PRACTICALS*					
1	BES18L01	Basic Engineering Workshop	Lb	0	0/0	2/0	1
2	BES18ET1	Orientation to Entrepreneurship and Project Lab	ETL	0	0/0	2/0	1

Credits Sub Total: 20

		II SEMESTER					
S.NO.	SUBJECT CODE	SUBJECT NAME	Ty/ Lb/ ETL	L	T/ SLr	P/R	C
1	BMA18004	Biostatistics	Ty	3	1/0	0/0	4
2	BPH18002	Engineering Physics –II	Ty	2	0/1	0/0	3
3	BCH18002	Engineering Chemistry – II	Ty	2	0/1	0/0	3
4	BES18003	Environmental Science*	Ty	NON CREDIT COURSE			
		PRACTICALS*					
1	BEN18ET1	Communication Lab	ETL	1	0/0	2/0	1
2	BES18ET2	Basic Engineering Graphics	ETL	1	0/0	2/0	2
3	BES18L02	Integrated Physical Science Lab	Lb	0	0/0	2/0	1
4	BES18ET3	C Programming And Lab	ETL	1	0/0	2/0	2

Credits Sub Total: 16

TOTAL CREDITS: 36

C: Credits L: Lecture T: Tutorial S.Lr: Supervised Learning P: Problem / Practical R: Research
Ty/Lb/ETL: Theory /Lab/Embedded Theory and Lab   * Internal Evaluation

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		III SEMESTER					
S.NO.	SUBJECT CODE	SUBJECT NAME	Ty/ Lb/ ETL	L	T/ SLr	P/R	C
1	BBE19001	Electric Field and Machines	Ty	3	1/0	0/0	4
2	BBE19002	Biomedical Electronics	Ty	3	1/0	0/0	4
3	BBE19003	Introduction to Biofluid and Biosolid Mechanics	Ty	3	0/0	0/0	3
4	BBE19004	Basics of Allied Health Science	Ty	3	0/0	0/0	3
5	BEI19I01	Digital Logic Design for Biomedical Engineers	Ty	3	0/0	0/0	3
		PRACTICALS*					
1	BBE19L01	Allied Health Science Lab	Lb	0	0/0	3/0	1
2	BBE19L02	Anatomy and Physiology Lab	Lb	0	0/0	3/0	1
3	BEI19IL1	Biomedical Electronics Lab I	Lb	0	0/0	3/0	1

Credits Sub Total: 20

		IV SEMESTER					
S.NO.	SUBJECT CODE	SUBJECT NAME	Ty/ Lb/ ETL	L	T/ SLr	P/R	C
1	BMA18015	Advanced Mathematics for Biotechnology / Biomedical Engineers	Ty	3	1/0	0/0	4
2	BBE19005	Design and Applications of Biomaterials	Ty	3	1/0	0/0	4
3	BBE19006	Biological Micro-and Nanotechnology	Ty	3	0/0	0/0	3
4	BBE19007	Medical Radiological Health Engineering	Ty	3	0/0	0/0	3
5	BHS18NC1/ BHS18NC2	The Indian Constitution*/ The Indian Traditional Knowledge*	Ty	2	0/0	0/0	NC
		PRACTICALS*					
1	BBE19ET1	Bio-reaction Engineering and Design	ETL	1	0/1	3/0	3
2	BBE19L03	Biomedical Electronics Lab II	Lb	0	0/0	3/0	1
3	BBE19L04	Biomedical Engineering Lab I	Lb	0	0/0	3/0	1
4	BBE19L05	Massive open Online course(MOOC)/Swayam course	Lb	0	0/0	3/0	1
5	BBE19TS1	Technical Skill 1	Lb	0	0/0	3/0	1
6	BEN18SK1	Soft Skill 1(Career and Confidence Building)	ETL	0	0/0	3/0	1

Credits Sub Total: 22

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		V SEMESTER					
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/ Lb/ ETL**	**L**	**T/ SLr**	**P/R**	**C**
1	BBE19008	Bio Control Engineering	Ty	3	1/0	0/0	4
2	BBE19009	Sensors and Measuring techniques	Ty	3	0/0	0/0	3
3	BXX19EXX	Elective 1	Ty	3	0/0	00	3
4	BXX19OEX	Open Elective 1	Ty	3	0/0	00	3
		PRACTICALS*					
1	BBE19ET2	Biomedical Signals and Systems	ETL	1	0/1	3/0	3
2	BBE19L06	Biomedical Engineering Lab -II	Lb	0	0/0	3/0	1
3	BBE19L07	Bio-Control Engineering Lab	Lb	0	0/0	3/0	1
4	BBE19L08	Sensors and Measurements Lab	Lb	0	0/0	3/0	1
5	BBE19TS2	Technical Skill 2 (Industrial Module – I Evaluation)	Lb	0	0/0	3/0	1

Credits Sub Total: 20

		VI SEMESTER					
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**C**	**L**	**T/ SLr**	**P/R**	**Ty/ Lb/ ETL**
1	BBE19010	Rehabilitation Engineering and Assistive Technology	4	3	1/0	0/0	Ty
2	BBE19011	Biotransport Process	4	3	1/0	0/0	Ty
3	BXX19EXX	Elective II	3	3	0/0	0/0	Ty
4	BXX190EX	Open Elective 2	3	3	0/0	0/0	Ty
		PRACTICALS*					
1	BBE19ET3	Computational Modeling of Biological Tissues	ETL	1	0/1	3/0	3
2	BBE19L09	Massive open Online course(MOOC)/Swayam course	Lb	0	0/0	3/0	1
3	BBE19L10	Biomedical Engineering Lab- III	Lb	0	0/0	3/0	1
4	BEN18SK2	Soft Skill II (Qualitative and Quantitative Skills)	ETL	0	0/0	3/0	1
5	BBE19L11	Mini Project/In plant Training/Industrial training	Lb	0	0	3/0	1
6	BBE19TS3	Technical Skill 3	Lb	0	0/0	3/0	1

Credits Sub Total: 22

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S.NO.	SUBJECT CODE	SUBJECT NAME	Ty/ Lb/ ETL	L	T/ SLr	P/R	C
VII SEMESTER							
1	BBE19012	Ethics for Biomedical Engineers	Ty	3	1/0	0/0	4
2	BXX19EXX	Elective III	Ty	3	0/0	0/0	3
3	BXX19EXX	Elective IV	Ty	3	0/0	0/0	3
4	BIT17I01	Bio Informatics	Ty	3	0/0	0/0	3
PRACTICALS*							
1	BBE19ET4	Intellectual Property Rights and Biosafety	ETL	1	0/1	3/0	3
2	BBE19L12	Genetic Engineering Lab	Lb	0	0/0	3/0	1
3	BBT17L09	Bio Informatics Lab	Lb	0	0/0	3/0	1
4	BBE19L13	Project Phase – 1	Lb	0	0/0	3/3	2
5	BHS18FLX	Foreign Language (Evaluation)	Lb	0	0/0	3/0	1
6	BXX19OLX	Open Lab	Lb	0	0/0	3/0	1

Credits Sub Total: 22

S.NO.	SUBJECT CODE	SUBJECT NAME	Ty/ Lb/ ETL	L	T/ SLr	P/R	C
VIII SEMESTER							
1	BBE19013	IOT for Biomedical Sector	Ty	3	1/0	0/0	4
2	BBE19014	Occupational Biomechanics and Neuromechanics	Ty	3	0/0	0/0	3
3	BXX19EXX	Elective V	Ty	3	0/0	0/0	3
PRACTICALS*							
1	BBE19L14	Project (Phase – II)	Lb	0	0/0	12/12	8

Credits Sub Total: 18

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colspan ELECTIVE -I

S.NO.	SUBJECT CODE	SUBJECT NAME	Ty/ Lb/ ETL	L	T/ SLr	P/R	C
		ELECTIVE -I					
1	BBE19E01	Mechanics of Human Movement	Ty	3	0/0	0/0	3
2	BBE19E02	Life Sciences	Ty	3	0/0	0/0	3
3	BBI18E03	Biomaterials and Implantable Devices	Ty	3	0/0	0/0	3
4	BBE19E03	Computers in Medicine	Ty	3	0/0	0/0	3

S.NO.	SUBJECT CODE	SUBJECT NAME	Ty/ Lb/ ETL	L	T/ SLr	P/R	C
		ELECTIVE -II					
1	BBI18E04	Laser and Ultrasonic Application in Medicine	Ty	3	0/0	0/0	3
2	BBE19E04	CELLS in their Environment	Ty	3	0/0	0/0	3
3	BBE19E05	Bio MEMS	Ty	3	0/0	0/0	3
4	BBI18002	Medical Physics	Ty	3	0/0	0/0	3

S.NO.	SUBJECT CODE	SUBJECT NAME	Ty/ Lb/ ETL	L	T/ SLr	P/R	C
		ELECTIVE –III					
1	BBE19E06	Genetic Engineering	Ty	3	0/0	0/0	3
2	BBI18E09	Biological Effects of Radiation	Ty	3	0/0	0/0	3
3	BBI18E10	Drug Delivery Systems	Ty	3	0/0	0/0	3
4	BBI18E15	Hospital Management	Ty	3	0/0	0/0	3

S.NO.	SUBJECT CODE	SUBJECT NAME	Ty/ Lb/ ETL	L	T/ SLr	P/R	C
		ELECTIVE –IV					
1	BBE19E07	Clinical Observation and Needs Finding	Ty	3	0/0	0/0	3
2	BBE19E08	Tele Health Technology	Ty	3	0/0	0/0	3
3	BBE19E09	Robotics in Medicine	Ty	3	0/0	0/0	3
4	BBI18E13	Bio-Materials and Artificial Organs	Ty	3	0/0	0/0	3

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		ELECTIVE – V					
S.NO.	SUBJECT CODE	SUBJECT NAME	Ty/ Lb/ ETL	L	T/ SLr	P/R	C
1	BBI18E14	Recent Advances Applied to Hospital Engineering	Ty	3	0/0	0/0	3
2	BBE19E10	Cellular and Molecular Networks	Ty	3	0/0	0/0	3
3	BBE19E11	Biomedical Computing	Ty	3	0/0	0/0	3
4	BBE19E12	Stem Cells and Regenerative Technology	Ty	3	0/0	0/0	3

CREDIT SUMMARY

Semester: 1 : **20 Credits**

Semester: 2 : **16 Credits**

Semester: 3 : **20 Credits**

Semester: 4 : **22 Credits**

Semester: 5 : **20 Credits**

Semester: 6 : **22 Credits**

Semester: 7 : **22 Credits**

Semester: 8 : **18 Credits**

TOTAL CREDITS - **160**

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S.NO.	SUBJECT CODE	SUBJECT NAME	Ty/ Lb/ ETL	L	T/ SLr	P/R	C
		OPEN ELECTIVE					
1	BEE18OE1	Electrical Safety for Engineers	Ty	3	0/0	0/0	3
2	BEE18OE2	Energy Conservation Techniques	Ty	3	0/0	0/0	3
3	BEE18OE3	Electric Vehicle Technology	Ty	3	0/0	0/0	3
4	BEE18OE4	Biomedical Instrumentation	Ty	3	0/0	0/0	3
5	BEE18OE5	Introduction to Power Electronics	Ty	3	0/0	0/0	3
6	BEE18OE6	Industrial Instrumentation	Ty	3	0/0	0/0	3
7	BEE18OE7	Solar Energy Conversion System	Ty	3	0/0	0/0	3
8	BEE18OE8	Wind Energy Conversion System	Ty	3	0/0	0/0	3
9	BEE18OE9	Energy Storage Technology	Ty	3	0/0	0/0	3
		OPEN LAB					
1	BEE18OL1	Transducer Lab	Lb	0	0/0	3/0	1
2	BEE18OL2	PLC and SCADA Lab	Lb	0	0/0	3/0	1
3	BEE18OL3	Electrical Maintenance Lab	Lb	0	0/0	3/0	1
4	BEE18OL4	Power Electronics Lab	Lb	0	0/0	3/0	1
5	BEE18OL5	Bio Medical Instrumentation Lab	Lb	0	0/0	3/0	1

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DEPARTMENT OF ENGLISH

Subject Code: **BEN18001**	**Subject Name :TECHNICAL ENGLISH - I**	Ty/Lb/ETL	L	T/SLr	P/R	C
	Prerequisite : None	**Ty**	**1**	**0/0**	**2/0**	**2**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :

- Use appropriate vocabulary and structure in academic communication
- Use structural and functional grammar in academic writings.
- Give instructions, suggestions and recommendations.
- Interpret Charts, diagrams, advertisements, etc
- Take notes, summarize and make power point presentations.

COURSE OUTCOMES (Cos) : (3 – 5)

Students completing the course would be able to

CO1	Use appropriate vocabulary and structure in academic communication
CO2	Use structural and functional grammar in academic writings.
CO3	Give instructions, suggestions and recommendations.
CO4	Interpret Charts, diagrams, advertisements, etc
CO5	Take notes, summarize and make power point presentations.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										H		
CO2										H		
CO3										H		
CO4										H		
CO5										H		

H/M/L indicates strength of correlation   H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives		Open Electives	Practical / Project		Internship	Soft Skills
			√								

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BEN18001   **TECHNICAL ENGLISH - I**   **1   0/0   2/0   2**

UNIT I   VOCABULARYBUILDING   6
The concept of Word Formation-Root words and affixes from foreign languages and their use in English to form derivatives.-Homophones- Words often confused-Verbal analogy

UNIT II   BASIC WRITING SKILLS   6
Using Idioms and phrases in sentences-Sentence structures: statements, interrogative and imperative-Use of Conditional/if' clauses in sentences-Importance of proper punctuation-Creating coherence with sentence markers-Organizing coherent paragraphs in essays

UNIT III   IDENTIFYING COMMON ERRORS IN WRITING   6
Subject-verb   agreement-Noun-pronoun   agreement-   Misplaced   modifiers-Articles-Prepositions-Redundancies and Clichés

UNIT IV   WRITING PRACTICE- NATURE AND STYLE OF TECHNICAL WRITING   6
 Describing Gadgets- Defining Concepts-Classifying data-Comprehension-Essay Writing-Informal and Formal Letter Writing:

UNIT V   ORAL COMMUNICATION AND INTERACTIVE LEARNING   6
(This unit involves interactive practice sessions in Language Lab)
Activities to develop knowledge in Word formation, Vocabulary and analytical thinking–Instructions and –Recommendations–Formal and Informal Registers in Speech–Listening and taking notes

Total No of Periods: 30

TEXT BOOK :

        Quest : A Textbook of Communication Skills, Vijay Nicole, 2017.
        Pushkala, R, Padmasani Kannan S, Anuradha V, Chandrasena M Rajeswaran

SUGGESTED READINGS:

        (i) Practical English Usage. Michael Swan. OUP. 1995.
        (ii) Remedial English Grammar. F.T. Wood. Macmillan.2007
        (iii)On Writing Well. William Zinsser. Harper Resource Book. 2001
        (iv) Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
        (v) Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
        (vi) Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press
        (vi) Pronunciation in Use ,Mark Hancock. Cambridge University Press. 2012

Subject Code: **BMA18001**	**Subject Name :MATHEMATICS – I**		Ty/L b/ET L	L	T/SL r	P/R	C
	Prerequisite: None		Ty	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :

- Apply the Basic concepts in Algebra
- Use the Basic concepts in Matrices
- Identify and solve problems in Trigonometry
- Understand the Basic concepts in Differentiation
- Apply the Basic concepts in Functions of Several variables

COURSE OUTCOMES (Cos) : (3 – 5)
Students completing the course were able to

CO1	Find the summation of the given series of binomial, exponential & logarithmic
CO2	Transform a non – diagonal matrix into an equivalent diagonal matrix using orthogonal transformation.
CO3	Find expansion of trigonometric function into an infinite series and to separate a complex function into real and imaginary parts.
CO4	Apply knowledge and concepts in finding the derivative of given function and to find the maxima / minima of the given function.
CO5	Evaluate the partial / total differentiation and maxima / minima of a function of several variables.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H			M	M			H	H		H
CO2	H	H			H	L						H
CO3	H	H			M				M	H		L
CO4	H	H			L				M	H		M
CO5	H	H				M			M	M		H

H/M/L indicates strength of correlation   H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humaniti es & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internship s / Technical Skills	Soft Skills
	√								

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BMA18001   **MATHEMATICS – I**   **3   1/0   0/0 4**

UNIT I   ALGEBRA   12
Binomial, Exponential, Logarithmic Series (without proof of theorems) – Problems on Summation, Approximation and Coefficients.

UNIT II   MATRICES   12
Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values – Cayley - Hamilton theorem(without proof) – Orthogonal reduction of a symmetric matrix to Diagonal form.

UNIT III   TRIGONOMETRY   12
Expansions of Sin $n\theta$, Cos $n\theta$ in powers of Sinθ and Cosθ – Expansion of Tan $n\theta$ – Expansions of Sin$^n\theta$ and Cos$^n\theta$ in terms of Sines and Cosines of multiples of θ – Hyperbolic functions – Separation into real and imaginary parts.

UNIT IV   DIFFERENTIATION   12
Basic concepts of Differentiation – Elementary differentiation methods – Parametric functions – Implicit function –Leibnitz theorem(without proof) – Maxima and Minima – Points of inflection.

UNIT V   FUNCTIONS OF SEVERAL VARIABLES   12
Partial derivatives – Total differential – Differentiation of implicit functions – Taylor's expansion – Maxima and Minima by Lagrange's Method of undetermined multipliers – Jacobians.

Total No of Periods: 60

TEXT BOOKS:
1. Kreyszig E., Advanced Engineering Mathematics (10 th ed.), John Wiley & Sons, (2011).
2. Veerarajan T., Engineering Mathematics (for first year), Tata McGraw Hill Publishing Co., (2008).

REFERENCE BOOKS:
1. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, (2012).
2. John Bird, Basic Engineering Mathematics (5th ed.), Elsevier Ltd, (2010).
3. P.Kandasamy, K.Thilagavathy and K. Gunavathy, Engineering   Mathematics Vol. I (4th Revised ed.), S.Chand& Co., Publishers, New Delhi (2000).
4. John Bird, Higher Engineering Mathematics (5th ed.), Elsevier Ltd, (2006).

Subject Code: **BPH18001**	Subject Name :ENGINEERING PHYSICS - I		TY/ Lb/ ETL	L	T/S Lr	P/R	C
	Prerequisite : None		Ty	2	0/1	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :

- Outline the relation between Science, Engineering & Technology.
- Demonstrate competency in understanding basic concepts.
- Apply fundamental laws of Physics in Engineering & Technology.
- To identify & solve problems using physics concepts.
- Produce and present activities associated with the course through effective technical communication

COURSE OUTCOMES (Cos) : (3 – 5)

Students completing this course were able to

CO1	Demonstrate competency in understanding basic concepts.
CO2	Utilize scientific methods for formal investigations & demonstrate competency with experimental methods and verify the concept to content knowledge.
CO3	Identify and provide solutions for engineering problems.
CO4	Relate the technical concepts to day to day life and to practical situations.
CO5	Think analytically to interpret concepts.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H		M	M	M						
CO2	H	H	M	M	M	M			M	M		
CO3	H	H	H	M	M	M				M		M
CO4	H	H	M	M		M			M	M		M
CO5	H	H	M			M		M				L

H/M/L indicates strength of correlation   H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humaniti es & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internship s /	Technical Skills	Soft Skills
	√									

UNIT I　　　MECHANICS & PROPERTIES OF MATTER　　　9

Mechanics : Introduction- scalar and vector quantities - rigid body - moment of inertia - forces in nature - Newton's laws of motion - derivation of Newton's second law of motion - motion of rocket – dynamical concepts - kinematics - conservation of energy and momentum - conservative and non-conservative forces - mechanics of continuous media - friction and its applications.

Properties of Matter: Elasticity - stress, strain and Hook's law - Poisson's ratio - three moduli of elasticity - twisting couple on a wire - viscosity - flow of liquid through a narrow tube: Poiseuille's law - Ostwald`s viscometer - flow of blood in human body.

UNIT II　　　SHM AND ACOUSTICS　　　9

SHM: Simple harmonic motion - differential equation of SHM - graphical representation of SHM - average kinetic energy of vibration - total energy of vibration - free and forced vibrations - damped and undamped vibrations - resonance - transverse wave on a string - law of transverse vibration of string - verification of the laws of transverse vibration of string - standing waves.

Acoustics : Fundamentals of acoustics - reverberation- reverberation time - factors affecting acoustics Ultrasonics -Production of ultrasonic waves - detection of ultrasonic waves - acoustic grating - application of ultrasonic waves.

UNIT III　　　WAVE OPTICS　　　9

Huygen`s principle - interference of light - wavefront splitting and amplitude - airwedge - Newton`s rings - Michelson interferometer and its applications - Fraunhofer diffraction from a single slit - Rayleigh criterion for limit of resolution - diffraction grating and resolving power of a telescope.

UNIT IV　　　ELECTROMAGNETIC THEORY　　　9

Electric field - coulomb`s law - alternating emf - rms and average value of an alternating current & voltage - resistors, capacitors and inductor - energy stored in a capacitor - LCR circuit & resonance – magnetism- definition - types - Biot Savart law - energy stored in a magnetic field - Domain theory - electromagnetic induction - self and mutual inductance - Faraday`s law of electromagnetic induction - Lenz law.

UNIT V　　　LASER　　　9

Laser principle and characteristics - amplification of light by population inversion - properties of laser beams: mono-chromaticity, coherence, directionality and brightness - different types of lasers - Ruby laser-Nd-YAG laser-He-Ne laser-CO_2 laser - semiconductor laser - applications of lasers in science, engineering and medicine.

Total No of Periods : 45

TEXT BOOKS :
1. Brijlal, M. N. Avadhanulu& N. Subrahmanyam, Text Book of Optics, S. Chand Publications, 25th edition, 2012
2. R. Murugeshan, Electricity and Magnetism, S.Chand Publications, 10th edition, 2017
3. R. Murugeshan & Kiruthiga Sivaprasath, Modern Physics, S.Chand Publications, 2016

REFERENCE BOOKS:
1. Dr. Senthil Kumar Engineering Physics I VRB Publishers, 2016
2. N Subrahmanyam & Brijlal, Waves and Oscillations, Vikas Publications, New Delhi,1988
3. N Subrahmanyam & Brijlal, Properties of Matter, S. Chand Co., New Delhi, 1982
4. N Subrahmanyam & Brijlal, Text book of Optics, S. Chand Co., New Delhi, 1989
5. R. Murugeshan, Electricity and Magnetism, S. Chand & Co., New Delhi, 1995
6. Thygarajan K & Ajay Ghatak, Laser Theory and Applications, Macmillan, New Delhi, 1981

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DEPARTMENT OF CHEMISTRY

Subject Code: **BCH18001**	**Subject Name :ENGINEERING CHEMISTRY – I**	Ty/ Lb/ ETL	L	T/S Lr	P/R	C
	Prerequisite : None	Ty	2	0/1	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :

- Providing an insight into basic concepts of chemical thermodynamics.
- To create awareness about the water quality parameters, water analysis and softening of water from industrial perspective.
- Imparting fundamentals of emf, storage and fuel cells.
- Creating awareness about corrosion and its control methods.
- Introducing modern materials such as composites along with basic concepts of polymer chemistry and plastics.

COURSE OUTCOMES (Cos) : (1– 5)

CO1	Gain a clear understanding of the basics of chemical thermodynamics which include concepts such as Enthalpy, Entropy and Free energy.
CO2	Obtain an overall idea of Water quality parameters, Boiler requirements, problems, Water softening and Domestic Water treatment.
CO3	Improving the basic knowledge in electrical conductance and emf and also understand the chemical principles of storage devices.
CO4	Observe the information about corrosion and understand the mechanisms of corrosion and the methods of corrosion control.
CO5	Articulate the science of polymers and composites.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H										M
CO2	H	H	M	H		H	H					M
CO3	H	M	H				L					L
CO4	H		L	H								L
CO5	H											M

H/M/L indicates strength of correlation   H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills	
	√									

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BCH18001   **ENGINEERING   CHEMISTRY – I**   **2   0/1 0/0   3**

UNIT I   CHEMICAL THERMODYNAMICS   8

Introduction, Terminology in thermodynamics –System, Surrounding, State and Path functions, Extensive and intensive properties. Laws of thermodynamics – I and II laws-Need for the II law. Enthalpy, Entropy, Gibbs free energy, Helmholtz free energy - Spontaneity and its criteria. Maxwell relations, Gibbs - Helmholtz equation (relating E & A) and (relating H & G), Van't Hoff equations.

UNIT II   TECHNOLOGY OF WATER   9

Water quality parameters – Definition and expression. Analysis of water – alkalinity, hardness and its determination (EDTA method only). Boiler feed water and Boiler troubles-Scales and sludges, Caustic embrittlement, Priming and Foaming and Boiler corrosion. Water softening processes – Internal and external conditioning – Lime soda, Zeolite, Demineralisation methods. Desalination processes-RO and Electrodialysis .Domestic water treatment.

UNIT III   ELECTROCHEMISTRY AND ENERGY STORAGE DEVICES   10

Conductance – Types of conductance and its Measurement. Electrochemical cells – Electrodes and electrode potential, Nernst equation – EMF measurement and its applications. Types of electrodes-Reference Books electrodes-Standard hydrogen electrode- Saturated calomel electrode-Quinhydrone electrode – Determination of P^H using these electrodes. Reversible and irreversible cells– Fuel cells- H_2–O_2 fuel cell, Batteries-Lead storage battery,Nickel– Cadmium and Lithium-Battery.

UNIT IV   CORROSION AND PROTECTIVE COATING   9

Introduction–Causes of Corrosion–Consequences- Factors affecting corrosion. Theories of corrosion-Chemical corrosion and Electrochemical corrosion. Methods of corrosion control – corrosion inhibitors, Sacrificial anode and Impressed current cathodic protection.
Protective coatings- Metallic coatings- Chemical conversion coatings-paints-Constituents and functions.

UNIT V   POLYMERS AND COMPOSITES   9

Monomers – Functionality – Degree of polymerization-Tacticity.Polymers – Classification, Conducting Polymers,Biodegradable polymers- Properties and applications.Plastics – Thermoplastics and thermosetting plastics,Compounding of plastics – Compression moulding, injection moulding and extrusion processes. Polymer composites-introduction-Types of composites-particle reinforced-fiber reinforced-structural composites-examples. Matrix materials, reinforcement materials-Kevlar, Polyamides, fiber glass, carbon fibers, ceramics and metals .

Total No of Periods: 45

TEXTBOOKS:
1. P.Udhayakala., S.Dinakar&L.Sankar., "Chemistry for Engineers", Charulatha Publications(2018).
2. C.SreekuttanUnnithan, "Applied Chemistry", Sreelakshmi Publications, (2007).
3. Dr.R.Sivakumar, Dr.R.Jayaprakasam and Dr.N.Sivakumar, "Engineering Chemistry – I & II", Tata McGraw Hill Publishing Company Ltd, Reprint 2013.

REFERENCE BOOKS:
1. P.C. Jain & Monika Jain, "Engineering Chemistry", Dhanpat Rai publishing Co., (Ltd.) (2013).
2. J. C. Kuriacose& J. Rajaram, "Chemistry in Engineering & Technology", Tata Mc Graw Hill (1996).
3. B.R.Puri, L.R.Sharma&M.S.Pathania, "Principles of Physical Chemistry", Vishal publishing co., (2013).

Subject Code: **BES18001**	**Subject Name :BASIC ELECTRICAL AND ELECTRONICS ENGINEERING**	Ty/ Lb/ ETL	L	T/S Lr	P/R	C
	Prerequisite : None	**Ty**	**2**	**0/1**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :

- Understand the concepts of circuit elements, circuit laws and coupled circuits.
- Acquire knowledge on conventional &non conventional energy production.
- Gain information on measurement of electrical parameters.
- Identify basic theoretical principles behind the working of modern electronic gadgets.
- Demonstrate digital electronic circuits and assemble simple devices.

COURSE OUTCOMES (Cos) : (3 – 5)

CO1	Students understand Fundamental laws and theorems and their practical applications
CO2	Predict the behavior of different electric and magnetic Circuits.
CO3	Identify conventional and Non-conventional Electrical power Generation, Transmission and Distribution.
CO4	Identify & Apply schematic symbols and understand the working principles of electronic devices
CO5	Analyze basics of digital electronics and solving problems and design combinational circuits

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H							M	L
CO2	H	H	H	M	M		M				M	
CO3	H	M	H	M	H		M		M			L
CO4	H	M		M			M				M	L
CO5	H	M	H	M	H				M		M	L

H/M/L indicates strength of correlation   H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
		√							

BES18001   BASIC ELECTRICAL AND ELECTRONICS ENGINEERING   2   0/1   0/0   3

UNIT I   ELECTRIC CIRCUITS   9
Electrical Quantities – Ohms Law – Kirchhoff's Law – Series and Parallel Connections – Current Division and Voltage Division Rule - Source Transformation – Wye (Y) – Delta (Δ) , Delta (Δ) – Wye (Y) Transformation – Rectangular to Polar and Polar to Rectangular.

UNIT II   MACHINES & MEASURING INSTRUMENTS   9
Construction & Principle of Operation of DC motor & DC Generator – EMF equation of Generator – Torque Equation of Motor – Construction & Principle of operation of a Transformer – PMMC – Moving Iron types of meter – Single Phase Induction Type Energy Meter.

UNIT III   BASICS OF POWER SYSTEM   9
Generation of Electric Power (Thermal, Hydro, Wind and Solar) – Transmission & Distribution of Electric Power – Types of Transmission & Distribution Schemes – Representation of Substation.

UNIT IV   ELECTRON DEVICES   9
Passive Circuit Components-Classification of Semiconductor-PN Junction Diode-Zener diode-Construction and Working Principle –Applications--BJT-Types of configuration-JFET.

UNIT V   DIGITAL SYSTEM   9
Number System – Binary, Decimal, Octal, Hexadecimal – Binary Addition Subtraction, Multiplication & Division– Boolean Algebra – Reduction of Boolean Expressions – Logic Gates - De-Morgan's Theorem , Adder – Subractor.

Total No of Periods: 45

TEXT BOOKS:
1. D P Kothari, I J Nagrath, Basic Electrical Engineering, Second Edition, , Tata McGraw-Hill Publisher
2. A Course In Electrical And Electronic Measurements And Instrumentation,A.K. Sawhney, publisher DHANPAT RAI&CO
3. Text Book of Electrical Technology: Volume 3: Transmission, Distribution and Utilization,B.L.Theraja, A.K.Theraja, publisher S.CHAND
4. Morris Mano, M. (2002) Digital Logic and Computer Design. Prentice Hall of India
5. Millman and Halkias1991, Electronic Devices and Circuits , Tata McGraw Hill,

REFERENCE BOOKS:

1. R.Muthusubramanian, S.Salivahanan, K A Muraleedharan, Basic Electrical, Electronics And Computer Engineering, Second Edition, ,Tata McGraw-Hill publisher.

DEPARMENT OF MECHANICAL ENGINEERING

Subject Code: **BES18002**	Subject Name : **BASIC MECHANICAL AND CIVIL ENGINEERING**	Ty/ Lb/ ETL	L	T/SLr	P/R	C
	Prerequisite : None	**Ty**	**2**	**0/1**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :

- Learn Basics of Internal Combustion Engines, power plants and boilers
- Demonstrate How metals are formed, joined, using machining operations Lathe, Milling and Drilling machines
- To identify & solve problems in Engineering Mechanics
- Learn basics of Building materials and construction
- Know the basic process of concrete, types of masonry Construction of Roads , Railways, Bridges and Dams

COURSE OUTCOMES (Cos) : (3 – 5)
Students completing the course were able to

CO1	Demonstrate the working principles of power plants, IC Engines and boilers..
CO2	Utilize the concept of metals forming, joining process and apply in suitable machining process
CO3	Identify and provide solutions for problems in engineering mechanics
CO4	Utilize the concept of Building materials and construction able to perform concrete mix and masonry types
CO5	Demonstrate how Roads, Railways, dams, Bridges have been constructed

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H					M		H	H	H		H
CO2	H				L	M		M	M	M		M
CO3	H	H			L	L		M	M	M		M
CO4	H				L	L			M	M		M
CO5	H				L	L		M	M	M		M

H/M/L indicates strength of correlation   H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
		√							

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BES18002   **BASIC MECHANICAL AND CIVIL ENGINEERING**   2   0/1   0/0   3

UNIT I   THERMAL ENGINEERING   9
Classification of internal combustion engine – two stroke, four stroke petrol and diesel engines. Classification of Boilers – Cochran boiler – Locomotive boilers – Power plant classification – Working of Thermal and Nuclear power plant

UNIT II   MANUFACTURING PROCESS   13
Metal forming processes – Rolling, forging, drawing, extrusion and sheet metal operations- fundamentals only. Metal Joining processes – Welding - arc and gas welding, Soldering and Brazing. Casting process – Patterns -Moulding tools - Types of moulding - Preparation of green sand mould -Operation of Cupola furnace.
Basics of metal cutting operations – Working of lathe- parts-Operations performed. Drilling machine – Classification – Radial drilling machine - Twist drill nomenclature

UNIT III   MECHANICS   9
Stresses and Strains – Definition – Relationship – Elastic modulus – Centre of gravity – Moment of Inertia – Problems. (Simple Problems Only).

UNIT IV   BUILDING MATERIALS AND CONSTRUCTION   7
Materials:Brick - Types of Bricks - Test on bricks - Cement – Types, Properties and uses of cement – Steel - Properties and its uses – Ply wood and Plastics.
Construction:Mortar – Ingredients – Uses – Plastering - Types of mortar - Preparation – Uses – Concrete – Types – Grades – Uses – Curing – Introduction to Building Components (foundation to roof) – Masonry – Types of masonry (Bricks & Stones)

UNIT V   ROADS, RAILWAYS, BRIDGES & DAMS   7
Roads – Classification of roads – Components in roads – Railways -Components of permanent way and their function – Bridges – Components of bridges – Dams – Purpose of dams – Types of dams.

Total No of Periods : 45

TEXT BOOKS:
1. S. Bhaskar, S. Sellappan, H.N.Sreekanth,, (2002), "Basic Engineering" –Hi-Tech Publications
2. K. Venugopal, V. Prabhu Raja, (2013-14), "Basic Mechanical Engineering", Anuradha Publications.
3. K.V. Natarajan (2000), Basic Civil Engineering,Dhanalakshmi Publishers
4. S.C. Sharma(2002),Basic Civil Engineering,Dhanpat Raj Publications

REFERENCE BOOKS:
1. PR.SL. Somasundaram, (2002), "Basic Mechanical Engineering" –, Vikas Publications.
2. S.C. Rangawala(2002), Building Material and Construction, S. Chand Publisher

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DEPARTMENT OF ENGINEERING SCIENCES

Subject Code: **BES18L01**	Subject Name :**BASIC ENGINEERING WORKSHOP**		Ty / Lb/ ETL	L	T/ SLr	P/ R	C
	Prerequisite : None		**Lb**	**0**	**0/0**	**2/0**	**1**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :
- Familiarize the plumbing tools, fittings, carpentry tools, etc.
- Identify basic electrical wiring and measurement of electrical quantities.
- Identify Electronic components ,logic gates and soldering process
- Display simple fabrication techniques
- Execute a project independently and make a working model

COURSE OUTCOMES (Cos) : (3 – 5)
Students completing the course were able to

CO1	Demonstrate fitting tools and carpentry tools, & Perform the process of Filing, Chipping, Cutting.
CO2	Perform the process of fabrication of tray, cones and funnels, Tee Halving Cross, Lap Joint Martise& Joints
CO3	Demonstrate various types of wirings and other equipments.
CO4	Measure fundamental parameters using the electronic instruments

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	M	M			L	M			L
CO2	H		H	L	M			L	L			
CO3	H		M	L				L	L			
CO4	H	H	M	L				L	L			M
CO5												

H/M/L indicates strength of correlation   H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical /	Internships / Technical Skills		Soft Skills
							√			

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BES18L01   **BASIC ENGINEERING WORKSHOP   0 0/0 2/0 1**.

MEP   PRACTICE

1. **FITTING :**
   Study of fitting tools and Equipments – Practicing, filing, chipping and cutting – making V-joints,
   half round joint, square cutting and dovetail joints.

2. **CARPENTRY:**
   Introduction – Types of wood – Tools – Carpentry processes – Joints – Planning practice – Tee Halving Joint – Cross Lap Joint – Maritse and Tenon Joint – Dovetail Joint

3. **SHEET METAL:**
   Study of tools and equipments – Fabrication of tray, cones and funnels.

CIVIL ENGINEERING PRACTICE

1. Study of Surveying and its equipments

2. Preparation of plumbing line sketches for water supply and sewage lines

3. Basic pipe connection using valves, laps, couplings, unions, reduces and elbows in house hold fittings

ELECTRICAL ENGINEERING PRACTICE

1. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.

2. Measurement of energy using single phase energy meter.

3. Measurement of resistance to earth of electrical equipment.

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

5. Fluorescent lamp wiring.

6. Stair case wiring

ELECTRONIC ENGINEERING PRACTICE

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak- peak, rms period, frequency) using CRO

2. Soldering practice – Components Devices and Circuits – Using general purpose P

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Abdul Kalam CoE for Innovation & Entrepreneurship

Subject Code : BES18ET1	Subject Name : ORIENTATION TO ENTREPRENEURSHIP AND PROJECT LAB	Ty / Lb/ ETL	L	T/SLr	P/R	C
	Prerequisite : None	ETL	0	0/0	2/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :
- Understand how entrepreneurship Education transforms individuals into successful leaders.
- Identify individual potential &S have career dreams
- Understand difference between ideas & opportunities
- Identify components & create action plan.
- Use brainstorming in a group to generate ideas.

COURSE OUTCOMES (Cos) : (3 – 5)

CO1	Develop a Business plan & improve ability to recognize business opportunity
CO2	Do a self analysis to build a entrepreneurial career.
CO3	Articulate an effective elevator pitch.
CO4	Analyze the local market environment & demonstrate the ability to find an attractive market
C05	Identify the required skills for entrepreneurship & develop

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M	M	H	M	M	M		M	M	M	L
CO2	H	M		H	M	H	M	H	H	H	M	M
CO3		M	M	M		H		H	H	H		
CO4		H	M	M	M	M		H	M	M	H	
CO5		M	M	H	M	M	H	H	M	M	H	L

H/M/L indicates strength of correlation   H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical skills	Soft Skills
							√		

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BES18ET1   ORIENTATION TO ENTREPRENEURSHIP AND PROJECT LAB   0 0/0 2/0 1

UNIT I   CHARACTERISTICS OF A SUCCESSFUL ENTREPRENEUR

Introduction to entrepreneurship education – Myths about entrepreneurship – How has entrepreneurship changed the country – Dream it. Do it - Idea planes - Some success stories – Global Legends – Identify your own heroes.

UNIT II   ENTREPRENEURIAL STYLE

Entrepreneurial styles – Introduction, concept & Different types - Barrier to Communication – Body language speaks louder than words

UNIT III   DESIGN THINKING

Introduction to Design thinking – Myth busters – Design thinking Process - Customer profiling – Wowing your customer – Personal selling – concept & process – show & tell concept – Introduction to the concept of Elevator Pitch

UNIT IV   RISK MANAGEMENT

Introduction to risk taking & Resilience – Managing risks (Learning from failures, Myth Buster) – Understanding risks through risk takers – Why do I do? – what do I do ?

UNIT V   PROJECT
How to choose a topic – basic skill sets necessary to take up a project – creating a prototype – Pitch your project – Project presentation.

Total No of Periods : 15

REFERENCE BOOKS & WEBSITE:

1. Encyclopedia of small Business (2011) – (e book)
2. Oxford Handbook of Entrepreneurship (2014) (ebook)
3. lms.learnwise.org

Subject Code : **BMA18004**	**Subject Name : BIO STATISTICS**	**C**	**L**	**T/SLr**	**P/R**
	Prerequisite : None	**4**	**3**	**1/0**	**0/0**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :
- Understand the Basic concepts in Statistics
- Use the Basic concepts in Correlation
- Understand the Basic concepts in Probability theory
- Apply the Basic concepts in Testing of Hypothesis
- Analyze the Basic concepts in Design of Experiments

COURSE OUTCOMES (Cos) : (3 – 5)
Students completing the course were able to

CO1	Find the measures of central tendency and to find the measures of dispersion.
CO2	Evaluate the moments measures of skewness and kurtorsls and to evaluate correlation and regression.
CO3	Apply knowledge and concepts in finding the probability of a random variable and use addition and multiplication laws of Probability
CO4	Have ability to test and to give conclusion in testing of hypothesis.
CO5	Analyze and interpret results through one way and two way ANOVA

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H				H			M		M	M
CO2	H	H				H			L			H
CO3	H	H	L		L	M			L		L	H
CO4	H	H	L		L	M			M			H
CO5	H	H	H	M					M			H

H/M/L indicates strength of correlation   H – High- M – Medium- L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
	√								

UNIT I   BASICS OF STATISTICS   12

Variables – Uni-variate Data – Frequency Distribution – Measures of Central Tendency – Mean –Median –Mode – Quartiles – Measures of Dispersion – The Range – Quartile Deviation –Standard Deviation.

UNIT II   CORRELATION   12

Measures of Skewness& Kurtosis – Bi-variate data – Correlation & Regression.

UNIT III   PROBABILITY AND RANDOM VARIABLE   12

Definition of Random Experiment - Sample Space – Events: Mutually exclusive events - Exhaustive events - Dependent events and Independent events - Mathematical and Statistical definition of probability - Theorems of addition and multiplication laws of Probability (Without proof) - Conditional probability (Simple problems).

UNIT IV   SAMPLING   12

Tests of Significance – Large Sample Tests – Mean – Proportions – Small Sample Tests – t- F & Chi-square Tests – Independence of Attributes – Goodness of Fit.

UNIT V   DESIGN OF EXPERIMENTS   12

Analysis of Variance: One Way & Two-Way Classification – Design of Experiments – Randomized Block Design – Completely Randomized Block Design – Latin Square Design.

Total no of Periods: 60

TEXT BOOKS:

1. Gupta S.C- Kapoor V.K- Fundamentals of Mathematical Statistics-S.Chand& Co- New Delhi(2003).
2. Veerarajan T.- Probability- Statistics and- Random Processes- Tata McGraw Hill Publishing Co.- (2008).

REFERENCE BOOKS:

1. Gupta S.P- Statistical Methods-S.Chand& Co.- New Delhi (2003).
2. Singaravelu- Probability and Random Processes- Meenakshi Agency- (2017).
3. Richard Johnson A.- Miller & Freund's Probability and statistics for Engineers (9[th]ed)- Prentice Hall of India- (2016).

Subject Code : BPH18002	Subject Name : ENGINEERING PHYSICS –II	Ty / Lb/ ETL	L	T/ SLr	P/R	C
	Prerequisite : None	Ty	2	0/1	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :

- Design, conduct experiment and analyze data.
- Develop a Scientific attitude at micro and nano scale of materials
- Understand the concepts of Modern Physics
- Apply the science of materials to Engineering & Technology

COURSE OUTCOMES (Cos) : (3 – 5)

Students completing the course were able to

CO1	Demonstrate skills necessary for conducting research related to content knowledge and laboratory skills.
CO2	Apply knowledge and concepts in advanced materials and devices.
CO3	Acquired Analytical, Mathematical skills for solving engineering problems.
CO4	Ability to design and conduct experiments as well as function in a multi disciplinary teams.
CO5	Generate analytical thought to interpret results & place them within a broader context

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	M	M	M	L				M		L
CO2	H	H		M	M							L
CO3	H	H	H	H	M					M		
CO4	H	H	H	H	M				H	M		L
CO5	H	M	M	M	M	L			M	M		L

H/M/L indicates strength of correlation   H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships /	Soft Skills
	√								

UNIT I   QUANTUM   PHYSICS   9

Quantum free electron theory - deBroglie waves - derivation of deBroglie waves - Davisson and Germer experiment - uncertainty principle - electron microscope - scanning electron microscope - physical significance of wave function - Schrodinger wave equation and its applications - Fermi energy- effective mass - phonons - Fermi function-density of states - origin of bandgap in solids - 1D scattering of electrons in periodic potential.

UNIT II   SEMICONDUCTORS   9

Introduction - properties of semiconductors - classification of semiconductor - effect of temperature in semiconductor - hole current - carrier concentration in intrinsic semiconductor (electron and hole density) - variation of Fermi energy level and carrier concentration with temperature in an intrinsic semiconductor - carrier transport - diffusion - drift - mobility - Hall effect - determination of Hall coefficient and its applications - diodes.

UNIT III   LIGHT SEMICONDUCTOR INTERACTION   9

Types of electronic materials: metals, semiconductors and insulators - qualitative analysis of extrinsic semiconductor & its applications - optical transition in bulk semiconductors: absorption, spontaneous and stimulated emission - exciton and its types - traps and its types - colour centers and its types and importance - luminescence - classifications of luminescence based on excitation - optical loss and gain - Photovoltaic effect - Photovoltaic potential - spectral response - solar energy converters - solar cells.

UNIT IV   OPTO ELECTRONIC DEVICES   9

Photodetectors - photoconductors - photodiodes principle, construction, working and characteristics   - Phototransistors - Laser diodes - LED theory, construction and working - seven segment display, advantages of LED - LCD theory, construction and working.

UNIT V   ENGINEERED MATERIALS   9

Classification of engineered materials - nano phase materials - its synthesis and properties - shape memory alloys and its applications - biomaterials - non linear materials - metallic glasses - metamaterials - homo and hetero junction semiconductors - semiconducting materials for optoelectronic devices - quantum wells, wires and dots.

Total No of Periods: 45

TEXT BOOKS :
1. P.K. Palanisamy, Semiconductor Physics and Optoelectronics, Scitech Publications, 2010
2. Jyoti Prasad Bandyopadhyay, Semicoductor Devices, S. Chand Publications, 2014
3. Charles Kittal, Introduction to Solid State Physics, Wiley Publications, 2012

REFERENCE BOOKS:
1. S. Shubhashree, S. Bharathi Devi & S. ChellammalMadhusudanan, Engineering Physics, Sree Lakshmi Publications, 2004
2. G. Senthil Kumar, N. Iyandurai, & G. Vijayakumar, Material Science, VRB Publishers, 2017
3. R.Murugeshan&Kiruthigasivaprakash, Modern Physics, 14th edition, S. Chand & Co,   2008
4. Pallab Bhattacharya, Semiconductor optoelectronic devices, second edition, Pearson Education, 2003
5. V Rajendran & A. Marikani, Materials Science, Tata McGraw- Hill, New Delhi, 2004

Subject Code : BCH18002	Subject Name: ENGINEERING CHEMISTRY – II	Ty / Lb/ ETL	L	T/SLr	P/R	C
	Prerequisite : None	Ty	2	0/1	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :
- Imparting the basic concepts of phase rule and apply the same to one and two component systems.
- Introducing the chemistry of engineering materials such as cement, lubricants,abrasives, refractories, alloys and nano materials.
- To impart a sound knowledge on the principles of chemistry involving different application-oriented topics
- Introducing salient features of fuels and combustion.
- To give an overview on modern analytical techniques

COURSE OUTCOMES (Cos) : (1 – 5)

CO1	Understand the science of phase equilibria and apply the phase rule to different systems.
CO2	Gain an overview of Engineering Materials such as Lime, Cement, Lubricants, Abrasives, Refractories,Alloys and Nanomaterials.
CO3	Recognize the essential information about consumer products such as Soaps and Detergents,also gaining the basic knowledge about Explosives and Propellants.
CO4	Discover the fuel Chemistry and Combustion process.
CO5	Inferring few important Analytical Techniques and their applications.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H											L
CO2	H		H			L	H					L
CO3	H					H						L
CO4	H	M	H	H			H					M
CO5	H				M							H

H/M/L indicates strength of correlation   H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
	√								

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BCH18002　　　　　　　**ENGINEERING CHEMISTRY – II**　　　　2 0/1 0/0 3

UNIT I　　　　**PHASE EQUILIBRIA**　　　　　　　　　　　　　　　**8**

Introduction – Definition of terms involved in phase rule. Derivation of Gibbs phase rule – Applications to one component system – water system. Binary system – Eutectic system – Pb – Ag system, Bi – Cd system.Thermal analysis – Cooling curves

UNIT II　　　　**MATERIAL CHEMISTRY**　　　　　　　　　　　　　**10**

Cement – Manufacture, Chemistry of setting and hardening. Lubricants – Requirements of good lubricants, Mechanism, Properties of lubricants, Classification – Examples. Abrasives–Classification –Moh's scale-Hard and soft abrasives, Preparation of artificial abrasives (silicon carbide, boron carbide), Applications of abrasives. Refractories – Classification, Properties-Refractoriness, RUL, Porosity, Thermal spalling Alloys Classification of alloys – Purpose of making alloys - Ferrous and non-Ferrous alloys - Heat treatment Nano materials – properties, carbon nano tubes – properties, fabrication – carbon arc method, laser vapourization method

UNIT III　　　　**APPLIED CHEMISTRY**　　　　　　　　　　　　　**9**

Soaps and detergents : Soaps – Saponification of oils and fats, manufacture of soaps, classification of soap – soft soap, medicated soap, herbal soap, shaving soap and creams.
Detergents – Anionic detergents – manufacture and applications, Comparison of soaps and detergents.
Rocket propellants and explosives: Rocket propellants – characteristics, solid and liquid propellants – examples. Explosives- Introduction, characteristics, classification, Oxygen balance , preparation, properties and uses of detonators, low explosives and high explosives, Dynamites, Gun cotton, Cordite.
Food adulterants- Common adulterants in different foods – milk and milk products, vegetable oils, and fats, spices and condiments, cereals, pulses, sweetening agents and beverages, Contamination with toxic chemicals – pesticides and insecticides.

UNIT IV　　　　**FUELS & COMBUSTION**　　　　　　　　　　　　**9**

Introduction to Fuels – classification – Calorific value – GCV, LCV. Solid Fuels–Coal-Proximate Analysis, Metallurgical Coke–Manufacture of Metallurgical Coke – Liquid Fuel–Refining of Petrol, Synthetic Petrol–Manufacturing Process–Hydrogenation of Coal, Polymerization, Cracking–Knocking–Octane Number–Leaded Petrol (or) Anti–knocking – Cetane Number–Ignition Lag–Gaseous fuels–CNG–LPG–Water Gas, Producer gas–Biogas- Combustion– Flue Gas analysis– Orsat's method.

UNIT V　　　　**ANALYTICAL AND CHARACTERIZATION TECHNIQUES**　　　　**9**

Electron microscopes: Scanning electron microscope & Transmission electron microscope, instrumentation and applications Absorption and Emission Spectrum - Beer - Lambert's law. Visible and UV Spectroscopy – instrumentation – Block diagram - working. IR Spectroscopy – instrumentation - Block diagram – molecular vibrations – stretching and bending – H_2O, CO_2. –Characterization of some important organic functional groups. Chromatographic techniques – column, thin layer and paper.

　　　　　　　　　　　　　　　　　　　　　　　Total No of Periods : 45

TEXTBOOKS :
1. P.Udhayakala., S.Dinakar&L.Sankar., "Chemistry for Engineers". Charulatha Publications (2018).
2. Dr.R.Sivakumar and Dr.N.Sivakumar" Engineering Chemistry" Tata McGraw Hill Publishing Company Ltd, Reprint 2013.
3. C. S.Unnithan, T. Jayachandran& P. Udhayakala, "Industrial Chemistry", Sreelakshmi Publications (2009).

REFERENCE BOOKS:
1. P.C. Jain & Monika Jain, "Engineering Chemistry", DhanpatRai publishing Co., (Ltd.) (2013).
2. B. R. Puri ,L.R. Sharma &M.S.Pathania, "Principles of Physical Chemistry", Vishal publishing co., (2013).

Subject Code : BES18003	Subject Name : ENVIRONMENTAL SCIENCE (Non- Credited)	Ty / Lb/ ETL	L	T/S Lr	P/R	C
	Prerequisite : None	Ty	-	-	-	-

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :
- To acquire knowledge of the Environment and Ecosystem & Biodiversity
- To acquire knowledge of the different types of Environmental pollution
- To know more about Natural Resources
- To gain understanding of social issues and the Environment
- To attain familiarity of human population and Environment

COURSE OUTCOMES (Cos) : (3 – 5)
Students completing the course were able to

CO1	To known about Environment and Ecosystem & Biodiversity
CO2	To clearly comprehend air, water, Soil, Marine, Noise, Thermal and Nuclear Pollutions and Solid Waste management and identify the importance of natural resources like forest, water, and food resources
CO3	To discover water conservation and watershed management
CO4	To identify its problems and concerns climate change, global warming, acid rain, ozone layer depletion etc.,
CO5	To explain family welfare programmes and role of information technology in human health and environment

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						M	H	M				M
CO2						M	H			M		M
CO3						M	H	M				M
CO4						M	H	M		M		M
CO5						M	H			M		M

H/M/L indicates strength of correlation   H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
			√						

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BES18003   **ENVIRONMENTAL SCIENCE**

UNIT I   ENVIRONMENT AND ECOSYSTEM
Definition, Scope and Importance of environment – need for public awareness – concept, structure and function of an ecosystem - producers, consumers and decomposers – energy flow in the ecosystem. Biodiversity at national and local levels – India

UNIT II   ENVIRONMENT POLLUTION
Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution   (f) Nuclear hazards (g) E-Wastes and causes, effects and control measures

UNIT III   NATURAL RESOURCES
Forest resources: Use and over-exploitation, deforestation. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems.

UNIT IV   SOCIAL ISSUES AND THE ENVIRONMENT
From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns climate change, global warming, acid rain, ozone layer depletion, nuclear accidents ,central and state pollution control boards- Public awareness.

 UNIT V   HUMAN POPULATION AND THE ENVIRONMENT
Population growth, variation among nations – population explosion, environment and human health – human rights – value education – HIV/AIDS – women and child welfare – role of information technology in environment and human health

TEXT BOOKS:
1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education (2004).
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGrawHill,NewDelhi, (2006).

REFERENCE BOOKS:
1. Vairamani, S. and Dr. K. Sankaran. **Elements of Environmental and Health Science.**Karaikudi: KPSV Publications, 5th Edition, July, 2013.
2. Ifthikarudeen, Etal, **Environmental Studies**, Sooraj Publications,2005.
3. R.Murugesan, **Environmental Studies,** Millennium Publishers and Distributors, 2nd Edition, July, 2009.

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DEPARTMENT OF ENGLISH

Subject Code: BEN18ET1	Subject Name :COMMUNICATION LAB	Ty / Lb/ ETL	L	T/S Lr	P/R	C
	Prerequisite : None	ETL	1	0/0	2/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :

The student should be able to

- Use appropriate vocabulary and structure for effective interpersonal and academic communication.
- Interpret charts, diagrams, advertisements, etc..
- Participate in group discussions and present projects effectively.
- Present projects and ideas effectively
- Attend interviews

COURSE OUTCOMES (Cos) : (3 – 5)
Students completing the course were able to

CO1	Use appropriate vocabulary and structure for effective interpersonal and academic communication
CO2	Interpret charts, diagrams, advertisements, etc.
CO3	Participate in group discussions and present projects effectively
CO4	Present projects and ideas effectively
CO5	Attend interviews

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										H		
CO2										H		
CO3										H		
CO4										H		
CO5										H		

H/M/L indicates strength of correlation   H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
			√						

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BET18ET1   **COMMUNICATION LAB**   1 0/0 2/0   1

UNIT I   **6**
Listening and Speaking- Informal and Formal Contexts

UNIT II   **6**
Interpretation of charts / Diagrams – Group Discussion

UNIT III   **6**
Compeering -Anchoring -Group Discussion

UNIT IV   **8**
Formal Presentation -Power point presentation of charts/ Diagrams

UNIT V   **4**
Interview

SUGGESTED READINGS:

(i) *Practical English Usage.* Michael Swan. OUP. 1995.
(ii) *Remedial English Grammar.* F.T. Wood. Macmillan.2007
(iii)*Study Writing.* Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
(iv) *Communication Skills*. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
(v) *Exercises in Spoken English.* Parts. I-III. CIEFL, Hyderabad. Oxford University Press
(vi) Pronunciation in Use ,Mark Hancock. Cambridge University Press. 2012

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code: BES18ET2	Subject Name : BASIC ENGINEERING GRAPHICS	Ty / Lb/ ETL	L	T/SLr	P/R	C
	Prerequisite : None	ETL	1	0/0	2/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :
- Learn to know what kind of pencils to be used to sketch lines, numbers, Letters and Dimensioning in drawing sheet.
- Draw Projection of points, line, planes and solids using Drafters
- To identify the angle of projection and development of surfaces, isometric projection and Orthographic projection
- Know the basics of elevation and plan of building.
- Learn the basics of Drafting using AutoCAD Software

COURSE OUTCOMES (Cos) : (3 – 5)
Students completing the course were able to

CO1	Utilize the concept of Engineering Graphics Techniques to draft letters, Numbers, Dimensioning in Indian Standards
CO2	Demonstrate the drafting practice visualization and projection skills useful for conveying ideas in engineering applications.
CO3	Identify basic sketching techniques of engineering equipments
CO4	Demonstrate the projections of Points, Lines, Planes and Solids.
CO5	Draw the sectional view of simple buildings and utilize Auto CAD Software.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	M	M	M			H	H		H
CO2	H	H	H	M	M	M			H	H		H
CO3	H	H	H	L		M			M	M		M
CO4	H	H	M	M		H		M	H	H		H
CO5	H	H	H	M	H	L		M	H	H		H

H/M/L indicates strength of correlation   H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
							√		

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BES18ET2   **BASIC ENGINEERING GRAPHICS**   **1 0/0 2/0 2**

CONCEPTS AND CONVENTIONS (Not for examination)   **3**
Introduction to drawing, importance and areas of applications – BIS standards – IS: 10711 – 2001 : Technical products Documentation – Size and layout of drawing sheets – IS 9606 – 2001: Technical products Documentation – Lettering – IS 10714 & SP 46 – 2003: Dimensioning of Technical Drawings – IS : 15021 – 2001 : Technical drawings – Projections Methods – drawing Instruments, Lettering Practice – Line types and dimensioning – Border lines, lines title blocks Construction of polygons – conic sections – Ellipse, Parabola, Hyperbola and cyloids.

UNIT I   PROJECTION OF POINTS, LINES AND PLANE SURFACES   6
Projection of points and straight lines located in the first quadrant – Determination of true lengths and true inclinations – projection of polygonal surface and circular lamina in simple position only.

UNIT II   PROJECTION OF SOLIDS   6
Projection of simple solids like prism, pyramid, cylinder and cone in simple position
Sectioning of above solids in simple vertical position by cutting plane inclined to one Reference Books plane and perpendicular to the other.

UNIT III   DEVELOPMMENT OF SURFACES AND ISOMETRIC PROJECTION   6
Development of lateral surfaces of simple and truncated solids – prisms, pyramids, cylinders, and cones. Principles of isometric projection – isometric scale – isometric projections of simple solids, like prisms pyramids, cylinders and cones.

UNIT IV   ORTHOGRAPHICS PROJECTIONS   6
Orthographic projection of simple machine parts – missing views

BUILDING DRAWING
Building components – front, Top and sectional view of a security shed.

UNIT V   COMPUTER AIDED DRAFTING   3
Introduction to CAD – Advantages of CAD – Practice of basic commands – Creation of simple components drawing using CAD software.

                                                                Total No of Periods :30
Note:First angle projection to be followed.

TEXT BOOKS:
1. Bhatt, N.D. and Panchal, V.M. (2014) Engineering Drawing Charotar Publishing House
2. Gopalakrishnan, K.R. (2014) Engineering Drawing (Vol.I& II Combined) Subhas Stores, Bangalore.

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Subject Code: BES18L02	Subject Name : INTEGRATED PHYSICAL SCIENCE LAB	Ty / Lb/ ETL	L	T/SLr	P/R	C
	Prerequisite : None	Lb	0	0/0	2/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :

- Demonstrate the ability to make physical measurements & understand the limits of precision in measurements.
- Display the ability to measure properties of variety of electrical, mechanical, optical systems.
- To help learners measure conductivity and EMF using electrical equipment.
- To understand the analytical skills through chromatography &viscometry
- To familiarize the concepts of cheminformatics

COURSE OUTCOMES (Cos) : (3 – 5)
Students completing the course were able to

CO1	Recognize the correctness and precision in the results of measurements.
CO2	Construct and compare the properties of variety of mechanical, optical, electrical and electronic systems.
CO3	Familiarizing the titration methods using conductometry & potentiometry
CO4	Developing the Research spirit through the knowledge of Cheminformatics & Analytical skills.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	L	H	H							
CO2	H	H	M	H	H					M		
CO3	H	H	M	H	H				H			
CO4	H	H	H	H	H				H		H	M

H/M/L indicates strength of correlation   H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Soft Skills
							√		

LIST OF EXPERIMENTS

1. Determination of Coefficient of Viscosity of a given liquid by Poiseuille`s method.

2. Particle Size determination using Laser Source.

3. Determination of Numerical Aperture of an Optical Fiber.

4. Spectrometer- Refractive Index/Dispersive power/i-d curve.

5. Potentiometer - Resistance of a wire.

6. Transistor Characteristics - Input Resistance, Output Resistance and Gain .

7. Studies on acid-base conductometric titration.

8. Determination of redox potentials using potentiometry.

9. Determination of R_f values of various components using thin layer chromatography.

10. Viscosity studies using Digital capillary viscometer.

11. Compute the structures of the given polymers, drugs, biomolecules usingChem Draw.

12. Studies on potential energy surface of the given molecules.

13. Estimate NMR spectra from a Chem Draw structure.

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DEPARTMENT OF COMPUTER SCIENCE

Subject Code : BES18ET3	Subject Name : C PROGRAMMING AND LAB	Ty / Lb/ ETL	L	T/S Lr	P/R	C
	Prerequisite : None	ETL	1	0/0	2/0	2

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :

- Outline the basics of C Language.

- Apply fundamentals in C programming.

- Produce and present activities associated with the course.

COURSE OUTCOMES (Cos) : (3 – 5)

Students completing the course were able to

CO1	Acquire knowledge how to write and execute c programs
CO2	Understand the fundamental expression and statements of C Language.
CO3	Work with arrays, functions, pointers, structures, Strings and Files in C.
CO4	Identify and provide solutions for engineering problems in C programming

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H			M	M		H	M			H
CO2	H	M			H	M		M	H			M
CO3	H			H		M		M	H			M
CO4	H			M		M		H	M			M

H/M/L indicates strength of correlation   H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
							√		

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BES18ET3   **C PROGRAMMING AND LAB**   1 0/0 2/0 2

UNIT I   INTRODUCTION   6
Fundamentals, C Character set, Identifiers and Keywords, Data Types, Variables and Constants, Structure of a C Program, Executing a C Program.

UNIT II   EXPRESSION AND STATEMENT   6
Operators, Types-Complex and Imaginary, Looping Statement-For, While, Do, Break, continue, Decision Statement-If, If else, Nested if, Switching Statement, Conditional Operator.

UNIT III   ARRAYS AND FUNCTIONS   6
Defining an Array, Using Array elements as counters, Generate Fibonacci number, Generate Prime Numbers, Initializing Arrays, Multidimensional Arrays, Defining a Function, Function call -types of Function calls - Function pass by value -Function pass by Reference Books, Write a Program in Recursive Function.

UNIT IV   STRUCTURES AND POINTERS   6
Working with Structures -Introduction -Syntax of structures -Declaration and initialization -Declaration of structure variable -Accessing structure variables, Understanding Pointers -Introduction -Syntax of Pointer.

UNIT V   STRINGS AND FILE HANDLING   6
Strings -Syntax for declaring a string -Syntax for initializing a string -To read a string from keyboard, Files in C -File handling functions -Opening a File closing a file --example: fopen, fclose -Reading data from a File-Problem solving in C

Total No of Periods: 30

1. **www.spoken-tutorials.org**
2. **http://www.learn-c.org/**

REFERENCE BOOKS:
1. Stephen G. Kochen" Programming in C- A complete introduction to the C Programming Language. Third Edition, Sams Publishing -2004
2. Ajay Mital, " Programming in C: A Practical Approach", Pearson Publication-2010

LIST OF PROGRAMS
1. Write a program to check 'a' is greater than 'b' or less than 'b' Hint: use if statement.
2. Write another program to check which value is greater 'a', 'b' or 'c'. Hint: use else-if statement. (Take values of a, b, c as user inputs)
3. Write a Program to find the sum of the series : $x + X^3/3! + X^5/5! + \ldots\ldots\ldots\ldots.. X^n/n!$
4. Write a C Program to solve a Quadratic Equation by taking input from Keyboard
5. Write a C Program to arrange 20 numbers in ascending and descending Order. Input the Numbers from Keyboard
6. Write a C Program to Multiply a 3 x 3 Matrix with input of members from Keyboard
7. Write a program that takes marks of three students as input. Compare the marks to see which student has scored the highest. Check also if two or more students have scored equal marks.
8. Write a program to display records of an employee. Like name, address, designation, salary.
9. Write a C program, declare a variable and a pointer. Store the address of the variable in the pointer. Print the value of the pointer.
10. Write a C program to concatenate String 'best' and String 'bus'. Hint: strcat(char str1, char str2);
11. Explore the other functions in string library.
12. Write a program to create a file TEST. Write your name and address in the file TEST. Then display it on the console using C program.

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Subject Code: BBE19001	Subject Name: ELECTRIC FIELD AND MACHINES	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	T	3	1/0	0/0	4

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL: Theory/Lab/Embedded Theory and Lab

OBJECTIVES:
- ➢ To gain Knowledge on vector concepts
- ➢ To study about static electric field
- ➢ To learn about steady magnetic field
- ➢ To gain knowledge on time varying electric and magnetic fields
- ➢ To learn about electrical machines

COURSE OUTCOMES (COs) : (3- 5)

CO1	Capable to analyze Vector concepts
CO2	Understands static electric field
CO3	Acquire the knowledge about steady magnetic field
CO4	Ability to analyze time varying electric and magnetic fields
CO5	Capable to analyze electrical machines

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	L	H	M	H	H	H	L	L	M	H
CO2	M	M	M	M	H	H	H	H	M	L	L	M
CO3	H	H	H	M	L	L	M	H	L	M	H	L
CO4	M	H	L	M	M	H	L	M	M	L	H	L
CO5	H	M	H	M	L	H	L	M	H	L	M	L

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	M	L
CO2	M	M	L
CO3	M	H	H
CO4	H	H	M
CO5	M	M	H

H/M/L indicates Strength of Correlation   H- High- M- Medium- L-Low

Category Approval	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

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BBE19001	ELECTRIC FIELD AND MACHINES	3	1/0	0/0	4

UNIT I   INTRODUCTION   12

Brief introduction to Vector Analysis - Coordinate systems (rectangular- cylindrical- spherical) & field theory.

UNIT II   STATIC ELECTRIC FIELD   12

Coulomb's law - electric field intensity - gauss's law – potential and its applications - Dielectrics- Permittivity- Polarization - Boundary relation - capacitance- Dielectric strength - Energy and energy density. Electric current- current density ohm's law continuity relations for current- problems - Poisson's and Laplace equations.

UNIT III   STEADY MAGNETIC FIELD   12

The biot saw art's law for magnetic fields and magnetic field intensity - ampere's law - magnetic materials - Ferro magnetism –hysteresis - magnetic dipoles - loops and solenoids – Magnetization – inductance - energy in an inductor and energy density - boundary relations - reluctance and permeance - problems

UNIT IV   TIME VARYING ELECTRIC AND MAGNETIC FIELDS   12

Faraday's law - Transformer and motional induction- Maxwell's equation from Faraday's law Self and Mutual Inductance – Displacement - Current- Maxwell's Equation from Ampere's law and its in consistency - Boundary relation - Brief introduction to waves & Pointing Vector - Comparison of field and circuit theory - Circuit application of Pointing Vector.

UNIT V   ELECTRICAL MACHINES   12

Principles of operation and characteristics of Transformers (Single-phase and Three-phase) - DC machines - Synchronous Machines - 3 phase and Single phase Induction motors(Op.principles).

Total No of Periods: 60

TEXT BOOKS:
1. John D.Krauss, "Electro Magnetism", Mc Graw Hill, 1999

REFERENCE BOOKS:
1. Hayt W.H, "Engineering Electromagnetics", Mc Graw Hill, 1995.

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Subject Code: BBE19002	Subject Name: BIOMEDICAL ELECTRONICS		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Introduction to Electronics		T	3	1/0	0/0	4

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To make the student basics of electron devices
- To impart knowledge on special semiconductor devices
- To impart knowledge onrectifiers- filters and regulators
- To educate on introduction to amplifiers
- To introduce the phenomenon of **Pulse** circuits

COURSE OUTCOMES (COs) : (3- 5)

CO1	Ability to analyze basics of electron devices
CO2	Ability to study special semiconductor devices
CO3	Ability to study rectifiers- filters and regulators
CO4	Gain knowledge about the phenomenon of amplifiers
CO5	Understands the concept of Pulse circuits

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	L	H	M	H	M	L	M	H
CO2	M	H	M	L	H	M	H	M	H	M	H	H
CO3	L	H	H	H	M	L	H	M	H	L	M	H
CO4	M	H	L	M	H	M	L	M	H	M	L	M
CO5	L	M	H	M	H	M	L	M	H	M	M	L

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	M
CO2	M	H	M
CO3	H	M	H
CO4	M	M	H
CO5	M	M	L

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

| BBE19002 | BIOMEDICAL ELECTRONICS | 3 | 1/0 | 0/0 | 4 |

UNIT I BASICS OF ELECTRON DEVICES 12

P-N junction diode characteristics-Zener diode characteristics - BJT- FET-JFET and MOSFETS characteristics-Study of Unijunction Transistor (UJT) –Study of SCR- DIAC and TRIAC.

UNIT II SPECIAL SEMICONDUCTOR DEVICES 12

Tunnel diode and characteristics- PIN diode- Varactor diode- Schottky diode- Gunn diode- Laser diode-photo conductive sensors- photo voltaic sensors- Light Emitting Diode (LED)- Liquid Crystal Display (LCD)- Charge coupled device (CCD).

UNIT III RECTIFIERS- FILTERS AND REGULATORS 12

Half wave rectifier- ripple factor- full wave rectifier- Harmonic components in a rectifier circuit-Inductor filter- Capacitor filter- Simple circuit of a regulator using zener diode - Series and Shunt voltage regulators-Study of clippers- clampers – voltage multipliers.

UNIT IV AMPLIFIERS 12

Small signal low frequency transistor amplifier circuits: h-parameter representation of a transistor-Analysis of single stage transistor amplifier using h-parameters: voltage gain - current gain - Input impedance and Output impedance. Comparison of transistor configurations.

UNIT V PULSE CIRCUITS 12

RC wave shaping circuits-Integrator and differentiator-switching diodes and transistors-storage time-Astable- monostable and bistablemultivibrators - Schmitt trigger- voltage/current sawtooth sweeps-fixed amplitude and constant current generators-UJT saw tooth generator-Miller and bootstrap time bases-Multivibrator using negative resistance devices (UJT and tunnel diodes)

Total No of Periods: 60

TEXT BOOKS:

1. J.Millman, C.C.Halkias and Satyabratha Jit, "Electronic Devices and Circuits"Tata McGraw Hill, 2nd Ed., 2007.
2. Leislie Cromwell, "Biomedical instrumentation and measurement", Prentice Hall of India- New Delhi, 2007.

REFERENCE BOOKS:

1. R.L. Boylestad and Louis Nashelsky,"Electronic Devices and Circuits", Pearson/Prentice Hall, 9th Edition, 2006.
2. P. Ramesh Babu, "Electronic Devices and Circuits",Scitech Publications Pvt- Ltd., 2008
3. Nagrath,"Electronic Devices and Circuits", PHI Learning, 2006

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Subject Code: BBE19003	Subject Name : INTRODUCTION TO BIOFLUID AND BIOSOLID MECHANICS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Introduction to Biomechanics	T	3	0/0	0/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To make the student demonstrate the stress and strain
- To impart knowledge on uniaxial and biaxial extension and compression- simple and pure shear- and inflation and extension of a residually stressed tube.
- To impart knowledge onintroduction to solid mechanics
- To educate on introduction to cardiovascular physiology.
- To introduce the phenomenon of **boundary** layermechanics.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Ability to analyze stress and strain
CO2	Ability to study uniaxial and biaxial extension and compression- simple and pure shear- and inflation and extension of a residually stressed tube
CO3	Ability tostudyintroduction to solid mechanics
CO4	Gain knowledge about the phenomenon of cardiovascular physiology
CO5	Understands the concept of boundary layer mechanics

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	L	H	M	H	M	L	M	H
CO2	M	H	M	L	H	M	H	M	H	M	H	H
CO3	L	H	H	H	M	L	H	M	H	L	M	H
CO4	M	H	L	M	H	M	L	M	H	M	L	L
CO5	L	M	H	M	H	M	L	M	H	L	M	L

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	M
CO2	H	H	M
CO3	H	M	H
CO4	M	H	H
CO5	M	H	L

H/M/L indicates Strength of Correlation   H- High- M- Medium- L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

BBE 19003   INTRODUCTION TO BIOFLUID AND BIOSOLID   3   0/0   0/0   3
MECHANICS

UNIT I   INTRODUCTION TO BIO-SOLID MECHANICS   9

Deformation and concept of strain - Stress-Compressibility - Poisson's ratio-Anisotropy- Viscoelasticity-Elasticity of soft and hard biological tissues- Elasticity of soft and hard biological tissues

UNIT II   BIO-SOLID MECHANICSOF SKELETAL SYSTEM   9

Bone structure &composition mechanical properties of bone- cortical and cancellous bones - Electrical properties of bone- fracture mechanism and crack propagation in bones- fracture fixators- repairing of bones. Pseudo elasticity-nonlinear stress-strain relationship- viscoelasticity- structure- function and mechanical properties of skin- ligaments and tendons.

UNIT III   STUDY AND CLASSIFICATIONS OF BIOFLUIDS   9

Fluids and non-fluids- continuum coordinate systems- force and moments- stress at a point- rate of strain- properties of fluids- classification of fluids -Different types of fluid flows-laminar and turbulent flow-transition from laminar to turbulent flow- laminar flow-annulus- laminar flow between parallel plates-measurement of viscosity

UNIT IV   BOUNDARY LAYER MECHANICS   9

Development of boundary layer- estimates of boundary layer thickness- boundary layer equation- nature of turbulence- smooth and rough surface- boundary layer separation.

UNIT V   CARDIOVASCULAR FLUID DYNAMICS   9

Friction loss in flow in a tube- velocity distribution of aortic system- waveform of pressure and velocity in aorta- wave reflections and impedance in arterial segments- blood flow in veins and blood flow in capillaries.

                                                                    Total No of Periods: 45

TEXT BOOKS:

1. Jay D. Humphrey, Cardiovascular Solid Mechanics- Springer New York, 2004.
2. Yuan-Cheng Fung, Biomechanics. Mechanical Properties of Living Tissues, 2nd Edition, Springer New York,1993.
3. K.L.Kumar, "Engineering fluid mechanics"- Eurasia Publishing House (P) Ltd., New Delhi, 1998.
4. D.H.Bergel, "Cardiovascular fluid dynamics", Vol. I, Academic press, London & New York, 1972.

REFERENCE BOOKS:

1. LublinerJacob, Papadopoulos,"Panayiotis Introduction to Solid Mechanics", An Integrated Approach, Springer, 2014.
2. Katz A.M.,"Physiology of the Heart", Lippincott Williams & Wilkins, New York, 2001.

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Subject Code: BBE19004	Subject Name: **BASICS OF ALLIED HEALTH SCIENCE**		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: BASICS IN BIOLOGY		T	3	0/0	0/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To introduce anesthesia
- To impart knowledge on pathology
- To educate on clinical microbiology and infection control.
- To introduce the phenomenon of first aid and nursing emergencies.
- To introduce clinical pharmacology

COURSE OUTCOMES (COs) : (3- 5)

CO1	Ability to introduce public health
CO2	Ability to take care of pathology
CO3	Ability tohandle clinical microbiology and infection control.
CO4	Gain knowledge aboutthe phenomenon of first aid and nursing emergencies
CO5	Understands the concept of clinical pharmacology

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	L	H	M	H	M	L	M	H
CO2	M	H	M	L	H	M	H	M	H	M	H	H
CO3	L	H	H	H	M	L	H	M	H	L	M	H
CO4	M	H	L	M	H	M	L	M	H	M	L	L
CO5	L	M	H	M	H	M	L	M	H	L	M	L

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	M
CO2	M	H	M
CO3	H	M	H
CO4	M	M	H
CO5	M	M	L

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

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BBE19004   **BASICS OF ALLIED HEALTH SCIENCE**   3   0/0   0/0   3

UNIT I   ANESTHESIA   9
Introduction to Monitoring of Gases- Inspired Oxygen Concentration (working principle of Galvanic Oxygen fuel cell-Servomex paramagnetic oxygen analyzer- Nitrous Oxide and the Volatile Agents: The Riken gas indicator-Bruel&Kjaer Anesthetic gas monitor- Raman anesthetic gas monitor- Hewlett-Packard main stream carbon dioxide gas analyzer. Anesthetic Room: Introduction- Layout of the Anesthetic Room- Contents of the Anesthetic Room.

UNIT II   PATHOLOGY   9
Natural and artificial immunity- types of Hypersensitivity- antibody and cell mediated tissue injury: opsonization- phagocytosis- inflammation- Secondary immunodeficiency including HIV infection. Auto-immune disorders: Basic concepts and classification- SLE.Antibodies and its types- antigen and antibody reactions- immunological techniques: immune diffusion-immuno electrophoresis- RIA and ELISA-monoclonal antibodies

UNIT III   CLINICAL MICROBIOLOGY   9
Preparation of samples for electron microscope. Staining methods – simple- gram staining and AFB staining - Structure of Bacteria and Virus. Routes of infection and spread; endogenous and exogenous infections- Morphological features and structural organization of bacteria and virus- growth curve- identification of bacteria - culture media and its types - culture techniques and observation of culture. Disease caused by bacteria- fungi- protozoal- virus and helminthes.

UNIT IV   FIRST AID AND NURSING EMERGENCIES   9
Definition- basic principles- scope and rules.-Wounds- hemorrhages- shock- fracture- dislocation and muscle injuries- respiratory emergencies--resuscitation- unconsciousness- Miscellaneous conditions-burns- scalds- foreign bodies in the skin--eyes- ear- nose- throat and stomach.-Frost bite- effects of heart cramps- bites and stings.-Poisoning.-Transporting injured persons.

UNIT V   CLINICAL PHARMACOLOGY   9
Drugs – Nomenclature- Mode of action of drugs- Routes of administration- Drug dose calculation - Dilution- infusion rate- Medical gases: O2; N20- Neuromuscular Blocking agents- Antimicrobial drugs-Anti Viral and Anti-Fungal agents - basic concepts –Antimicrobial- Resistance- Antiseptic agents

Total No of Periods: 45

TEXT BOOKS:
1. Textbook of Medical Laboratory Technology,RamnikSood- 6thEdition, Jaypee Brothers, Medical Publishers, 2009
2. Morris Brown Peter Bennet, "Clinical Pharmacology ", Churchill Livingstone, 2012.

REFERENCE BOOKS:

1. Morris Brown Peter Bennet, "Clinical Pharmacology", Elsevier, 2018.

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Subject Code:	Subject Name : **DIGITAL LOGIC DESIGN FOR BIOMEDICAL ENGINEERS**		T / L/ ETL	L	T / S.Lr	P/ R	C
BEI19I01	Prerequisite: BASICS IN Physics and digital electronics		T	3	0/0	0/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To introduce   digital fundamentals
- To impart knowledge on combinational circuit design
- To educate on synchronous sequential circuits.
- To introduce the phenomenon of memory devices.
- To introduce digital integrated circuit technologies

COURSE OUTCOMES (COs) : (3- 5)

CO1	Ability to introduce digital fundamentals
CO2	Ability to take care ofcombinational circuit design
CO3	Ability tohandle synchronous sequential circuits.
CO4	Gain knowledge aboutthe phenomenon of memory devices
CO5	Understands the concept of digital integrated circuit technologies

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	L	H	M	H	M	L	M	H
CO2	M	H	M	L	H	M	H	M	H	M	H	H
CO3	L	H	H	H	M	L	H	M	H	L	M	H
CO4	M	H	L	M	H	M	L	M	H	M	L	L
CO5	L	M	H	M	H	M	L	M	H	L	M	L

COs / PSOs	PSO1	PSO2	PSO3					
CO1	H	H	M					
CO2	M	H	M					
CO3	H	M	H					
CO4	M	M	H					
CO5	M	M	M					

H/M/L indicates Strength of Correlation   H- High- M- Medium- L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
		✓										

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BEI19I01   **DIGITAL LOGIC DESIGN FOR BIOMEDICAL**   **3**   **0/0**   **0/0**   **3**
                  ENGINEERS

UNIT I   DIGITAL FUNDAMENTALS   9
Analog and digital representation- Review of number systems-representation-conversions- 1's and 2'scomplement representation. Binary codes- error detection and error correction. Review of Boolean algebra-theorems- sum-of product and product of sum simplification- canonical forms - minterm andmaxterm- Simplification of Boolean expressions - Karnaugh map-implementation of Boolean expressions using universal gates-Applications in Biomedical equipment's.

UNIT II   COMBINATIONAL CIRCUIT DESIGN   9
Combinational logic circuits- adders- subtractors- BCD adder- ripple carry look ahead adders-paritygenerator- decoders- encoders- multiplexers- demultiplexers-Realisation of Boolean expressions-usingdecoders-using multiplexers. Sequential circuits - latches- flip-flops - SR- JK- D. T- and Master slave flip
flops- edge triggering- asynchronous inputs--Applications in Biomedical equipment's.

UNIT III   SYNCHRONOUS SEQUENTIAL CIRCUITS   9
Shift registers- Universal shift register- applications. Binary counters - Synchronous and asynchronousup/down counters- mod-N counter- Counters for random sequence-Multivibrators - Astable andMonostable multivibrators using gates-Their applications in Biomedical equipment's

UNIT IV   MEMORY DEVICES   9
Basic memory structure – ROM -PROM – EPROM – EEPROM –EAPROM- RAM – Static and dynamic RAM - Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using PLA- PAL-Their applications in Biomedical equipment's

UNIT V   DIGITAL INTEGRATED CIRCUIT TECHNOLOGIES   9
Logic levels- propagation delay- power dissipation- fan-out and fan-in- noise margin- logic families and their characteristics-RTL- TTL- ECL- CMOS--Their applications in Biomedical equipment's

Total No of Periods: 45

TEXT BOOKS:
1.   M. Morris Mano and Michael D. Ciletti, Digital Design‖, 5th Edition, Pearson, 2014
2.   Charles H.Roth., Fundamentals of Logic Design‖- 6th Edition, Thomson Learning, 2013
3.   Thomas L. Floyd, Digital Fundamentals‖- 10th Edition- Pearson Education Inc, 2011

REFERENCE BOOKS:

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.

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Subject Code: BBE19L01	Subject Name : ALLIED HEALTH SCIENCE LAB		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:		T	0	0/0	3/0	1

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To make the student demonstrate the functioning of compound microscope
- To impart knowledge on Blood Collection.
- To impart knowledge on blood related parameters
- To educate on characteristics of ECG.
- To introduce the phenomenon of EEG.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Ability to analyze functioning of compound microscope
CO2	Ability to study on Blood Collection
CO3	Ability to study introduction to monitoring of blood related parameters.
CO4	Gain knowledge about the phenomenon of ECG
CO5	Understands the concept of EEG.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	L	H	M	H	M	L	M	H
CO2	M	H	M	L	H	M	H	M	H	M	H	H
CO3	L	H	H	H	M	L	H	M	H	L	M	H
CO4	M	H	L	M	H	M	L	M	H	M	L	L
CO5	L	M	H	M	H	M	L	M	H	L	M	L

COs / PSOs	PSO1	PSO2	PSO3									
CO1	H	H	M									
CO2	M	H	M									
CO3	H	M	H									
CO4	M	M	H									
CO5	M	M	L									

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					

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BBE19L01   **ALLIED HEALTH SCIENCE LAB**   0   0/0   3/0   1

 LIST OF EXPERIMENTS

1. Study of parts of compound microscope
2. Identification of Blood Collection Tubes and Phlebotomy equipment's
3. Preparation of serum and plasma from blood.
4. Estimation of blood glucose.
5. Physical and chemical analysis of Urine(Estimation of creatinine- Estimation of urea- of Uric acid)
6. Estimation of cholesterol
7. Basic staining – Hematoxylin and eosin staining.
8. Capsule stain
9. Simple stain.
10. Gram stain.
11. Antigen-Antibody reaction Immuno electrophoresis.
12. Mechanical Stimulation of the eye- Near point and Near response
13. Tuning Fork test for Hearing
14. Peripheral pulse signal in different physical posture
15. Measurement and Analysis of ECG Signals
16. Measurement and interpretation of Heart sounds
17. Demonstration of Artificial respiration and Cardio Pulmonary Resuscitation.
18. Determination of Nerve conduction velocity
19. Measurement and Analysis of EEG signals
20. Anesthesia monitoring and control

Total No of Periods: 45

Subject Code: BBE19L02	Subject Name: ANATOMY AND PHYSIOLOGY LAB		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None		L	0	0/0	3/0	1

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- ➢ To understand the standard operating procedures of various anatomy instruments.
- ➢ To analyze the different biomolecules, present in the biological system using the analytical techniques

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understands the standard operating procedures of various anatomy instruments.
CO2	Capable to analyze the different biomolecules present in the biological system using the analytical techniques

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	L	H	M	L	M	H	L	L
CO2	M	H	M	H	L	- M	L	L	M	M	H	H
COs / PSOs	PSO1		PSO2		PSO3							
CO1	H		M		L							
CO2	M		M		H							

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					

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BBE19L02   **ANATOMY AND PHYSIOLOGY LAB**   **0   0/0   3/0   1**

LIST OF EXPERIMENTS

1. Study of human respiratory system
2. Study of human skeleton system
3. Study of human muscular system
4. Study of human reproductive system
5. Study of human urinary system
6. Study of the human nervous system
7. Study of human joint system
8. Study of human sense organ system
9. Recording of Muscle to Induced Electrical Stimulation
10. Study of rate of Conduction of Nerve Impulses.
11. Testing of Hearing using Tuning Fork.
12. Testing of various parameters of Vision and Errors of Refraction.
13. Testing for Detection of Glucose- Fructose and Starch.
14. General Test for Proteins.
15. Testing of Urine for presence of Sugar- Protein
16. Estimation using Spectrophotometer.

Total No of Periods:45

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Subject Code: BEI19IL1	Subject Name: BIOMEDICAL ELECTRONICS LAB – I	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	T	0	0/0	3/0	1

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To make the student demonstrate the functioning of PN junction and Zener diode
- To impart knowledge on rectifiers.
- To impart knowledge on totransistors- amplifiers and oscillators
- To educate on characteristics of SCR- TRIAC and DIAC.
- To introduce the phenomenon of pulsecircuits.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Ability to analyze functioningof PN junction and Zener diode
CO2	Ability to study on rectifiers
CO3	Ability to study introduction to transistors- amplifiers and oscillators.
CO4	Gain knowledge aboutthe phenomenon of SCR- TRIAC and DIAC
CO5	Understands the concept of **pulse circuits**

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	L	H	M	H	M	L	M	H
CO2	M	H	M	L	H	M	H	M	H	M	H	H
CO3	L	H	H	H	M	L	H	M	H	L	M	H
CO4	M	H	L	M	H	M	L	M	H	M	L	L
CO5	L	M	H	M	H	M	L	M	H	L	M	L

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	M
CO2	M	H	M
CO3	H	M	H
CO4	M	M	H
CO5	M	M	L

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					

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BEI19IL1   **BIOMEDICAL ELECTRONICS LAB –I**   0   0/0   3/0   1

LIST OF EXPERIMENTS

1. Characteristics of PN Junction diode
2. Characteristics of Zener diode
3. Half wave Rectifier with and without filters
4. Full wave Rectifier with and without filters
5. Characteristics of FET
6. Characteristics of transistor
7. Characteristics of CE Amplifier
8. Characteristics of CC amplifier
9. Single stage R-C coupled Amplifier.
10. Characteristics of Common Source FET amplifier
11. Study of Wien Bridge Oscillator
12. Study of RC Phase Shift Oscillator
13. Characteristics of SCR
14. Characteristics of DIAC
15. Characteristics of TRIAC
16. Study of Clippers
17. Study of Clampers
18. Study of RC wave shaping circuits

Total No of Periods: 45

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Subject Code: BMA18015	Subject Name: ADVANCED MATHEMATICS FOR BIO TECHNOLOGY/ BIOMEDICAL ENGINEERS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	T	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:
- To learn the Basic concepts in Algebra
- To study the Basic concepts in Matrices
- To acquire the knowledge on Basic concepts in Sequence and Series
- To learn the Basic concepts in Ordinary Differential equations
- To study the Basic concepts in Functions of several variables

COURSE OUTCOMES (COs) : (3- 5)

CO1	To understand the Basic concepts in Algebra
CO2	To understand the Basic concepts in Matrices
CO3	To understand the Basic concepts in Sequence and Series
CO4	To understand the Basic concepts in Ordinary Differential equations
CO5	To understand the Basic concepts in Functions of several variable

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	L	L	L	L	L	L	M	L	L	M
CO2	H	H	L	L	L	L	L	L	M	L	L	M
CO3	H	H	L	L	L	L	L	L	M	L	L	M
CO4	H	H	L	L	L	L	L	L	M	L	L	M
CO5	H	H	L	L	L	L	L	L	M	L	L	M

COs / PSOs	PSO1	PSO2	PSO3									
CO1	H	M	L									
CO2	H	M	L									
CO3	H	M	L									
CO4	H	M	L									
CO5	H	M	L									

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
	✓											

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**BMA18015   ADVANCED MATHEMATICS FOR BIO   3   1/0   0/0   4
                TECHNOLOGY/ BIOMEDICAL ENGINEERS**

UNIT I   ALGEBRA   12
Partial fractions – Binomial- Exponential- and Logarithmic Series (without proof of theorems) –
Problems on Summation- and Approximation (simple problems)

UNIT II   MATRICES II   12

Determinant – Simple properties – Symmetric & Skew symmetric matrices – Unitary matrix –
Characteristic equation – Eigen values and Eigen vectors of a real matrix – Cayley - Hamilton theorem
(without proof).

UNIT III   SEQUENCE AND SERIES   12
Basic definitions of Sequence and Series – Convergence & Divergence – Ratio test – Comparison test –
Cauchy's root test – Raabe's test. (simple problems)

UNIT IV   ORDINARY DIFFERENTIAL EQUATIONS   12
First order differential equations – Second and higher order linear differential equations with constant
coefficients and with RHS of the form: e^{ax}-x^n- Sin ax- Cos ax-$e^{ax}f(x)$- x f(x) where f(x) is Sin bx or Cos bx
– Differential equations with variable coefficients (Euler's form). (simple problems)

UNIT V   FUNCTIONS OF SEVERAL VARIABLES   12
Partial derivatives – Total differential – Differentiation of implicit functions – Taylor's expansion –
Maxima and Minima by Lagrange's Method of undetermined multipliers – Jacobians.

Total No of Periods: 60

REFERENCE BOOKS:

1. Kreyszig E. "Advanced Engineering Mathematics", (10th ed.), John Wiley & Sons, (2011).
2. Grewal B.S. Higher Engineering Mathematics- Khanna Publishers, (2012).
3. John Bird,"Basic Engineering Mathematics", (5th ed.), Elsevier Ltd, (2010).
4. Vittal P.R, "Vector analysis, Analytical solid geometry Sequences and series", (3rd ed.),Margham Publications- (2010).
5. Veerarajan T.,"Engineering Mathematics (for first year)", Tata McGraw Hill Publishing Co., (2008).
6. P.Kandasamy,K.Thilagavathy and K. Gunavathy, "Engineering Mathematics", Vol. I (4th Revised ed.)-S.Chand& Co.- Publishers, New Delhi (2000).
7. John Bird,"Higher Engineering Mathematics", 5th ed., Elsevier Ltd, 2006.

Subject Code: BBE19005	Subject Name: DESIGN AND APPLICATIONS OF BIOMATERIALS		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Introduction to Biomechanics		T	3	1/0	0/0	4

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To make the student understand the overview on biomaterials
- To impart knowledge on design of biomaterials
- To impart knowledge on evaluation of biomaterial behavior
- To educate on applications of biomaterials
- To introduce the phenomenon of biomaterials in prostheses production.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Ability to understand the overview on biomaterials
CO2	Ability to study the design of biomaterials
CO3	Ability to evaluate biomaterial behavior
CO4	Gain knowledge aboutthe applications of biomaterials
CO5	Understands the concept of biomaterials in prostheses production

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	L	H	M	H	M	L	M	H
CO2	M	H	M	L	H	M	H	M	H	M	H	H
CO3	L	H	H	H	M	L	H	M	H	L	M	H
CO4	M	H	L	M	H	M	L	M	H	M	L	M
CO5	L	M	H	M	H	M	L	M	H	M	M	L

COs / PSOs	PSO1	PSO2	PSO3				
CO1	H	H	M				
CO2	H	H	H				
CO3	H	M	H				
CO4	M	M	H				
CO5	M	M	L				

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

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| BBE19005 | DESIGN AND APPLICATIONS OF BIOMATERIALS | 3 | 1/0 | 0/0 | 4 |

UNIT I   OVERVIEW ON BIOMATERIALS   12
Definition of biomaterials- requirements of biomaterials-classification of biomaterials- Comparison of properties of some common biomaterials. Effects of physiological fluid on the properties of biomaterials. Biological responses (extra and intra-vascular system). Surface properties of materials- physical properties of materials- mechanical properties.

UNIT II   DESIGN OF IMPLANT BIOMATERIALS   12
 Stainless steel- Co-based alloys-Ti and Ti-based alloys. Importance of stress-corrosion cracking. Hosttissue reaction with biometal- corrosion behavior and the importance of passive films for tissue adhesion.

UNIT III   EVALUATION OF BIOMATERIAL BEHAVIOR   12
Assessment of physical properties- in vitro assessment- Testing of biomaterials - in vivo assessment- Experimental Assessment of properties of biomaterials

UNIT IV   APPLICATIONS OF BIOMATERIALS   12
Hard tissue replacement implant: Orthopedic implants- Dental implants. Soft tissue replacement implants: skin implants- Vascular implants- Heart valve implants-Orthopedic applications- ophthalmologic applications- dental applications-wound dressing applications.

UNIT V   BIOMATERIALS IN PROSTHESES PRODUCTION   12
New Developments in Tissue -Engineering of Microvascular Prostheses-Pericardial Processing:Challenges- Outcomes and Future Prospects

Total No of Periods: 60

TEXT BOOKS:

1. Black J.,"The education of the biomaterialist: report of a survey", J Biomed Mater Res 1982;16 (2):159 67, 1980-81
2. Kalita SJ. "Nanostructured biomaterials", Nano Sci Tech 2008:168 219.
3. Bronzino JD. "The biomedical engineering handbook", vol. 2. 2nd ed.; 2000.
4. Helmus MN, Gibbons DF,Cebon D. "Biocompatibility: meeting a key functional requirement of nextgeneration medical devices". ToxicolPathol 2008;36(1):70 80
5. ParkJ. B. and Lakes R. S. Biomaterials, Third edition, Springer, 2007

REFERENCE BOOKS:
1. Tathe A,Ghodke M,Nikalje AP. "A brief review: biomaterials and their application", Int J Pharm PharmSci 2010;2(4):19 23.
2. Ratner BD, Hoffman AS. "Biomaterials science: an introduction to materials in medicine", 1st ed. AcademicPress; 1996.

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Subject Code: BBE19006	Subject Name : BIOLOGICAL MICRO AND NANOTECHNOLOGY		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:		T	3	0/0	0/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To acquire knowledge on refutation of a biogenesis
- To learn about Sterilization
- To learn about ProtistsArchaebacteria
- To learn about Introduction and scientific revolutions
- To learn about biological nanotechnology

COURSE OUTCOMES (COs) : (3- 5)

CO1	Students will be able touse refutation of a biogenesis
CO2	Gain knowledge on Sterilization
CO3	Gain knowledgeonProtistsArchaebacteria
CO4	Gain knowledgeonIntroduction and scientific revolutions
CO5	Apply the biological nanotechnology in applications

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	M	H	M	H	M	M	H	M	H	M	H
CO2	H	M	H	M	L	H	H	M	H	M	H	L
CO3	M	H	H	H	H	M	M	H	M	M	M	H
CO4	M	H	M	L	M	H	H	H	M	L	L	L
CO5	M	H	H	H	H	M	H	H	M	M	M	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	M	M	H
CO2	L	M	L
CO3	H	M	H
CO4	M	H	M
CO5	M	H	H

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

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BBE19006	BIOLOGICAL MICRO AND NANOTECHNOLOGY	3	0/0	0/0	3

UNIT I   REFUTATION OF A BIOGENESIS   9

Discovery of penicillin: discovery of vaccination: proposal of one gene one enzyme hypothesis: discovery of double helix structure of DNA: discovery of recombinant DNA technology. Structural aspects – Components of DNA and RNA- Nucleosides & Nucleotides (introduction- structure & bonding)- Double helical structure of DNA (Watson - Crick Model)- various forms of DNA.

UNITII   STERILIZATION   9

Disinfection- Isolation- Purification and preservation of Mecrobes- Principles of staining of Microorganisms- Microscopy- Light phase contract-Epifluorescence and Election microscopy- Assay of Antibiotics.

UNITIII   PROTISTS ARCHAEOBACTERIA   9

Mosphyology and cycology- cycology of microfial cell- comparison of the cycological features of different groups of microorganisms- chemical nature of cell wall. Protoplasm- nucleus- granular materials and other inclusions of microbial cells

UNITIV   INTRODUCTION AND SCIENTIFIC REVOLUTIONS   9

Basics and scale of nanotechnology- different classes of nanomaterials- synthesis of nanomaterials- fabrication and characterization of nanostructures- applications-Carbon nanotubes

UNITVBIOLOGICAL NANOTECHNOLOGY   9

Quantum dots- wells and wires- Carbon-based nano materials – fullerenes and buckyballs- Metal based nano materials – Nanogold and Nano silver 1- Nanocomposites and nano polymers-Nano glasses and nano ceramics

Total No of Periods: 45

TEXT BOOK:

1. Apurba Sankar SastryJaypee Brothers, "Essentials of Medical Microbiology" Medical Pub (P) Ltd.

REFERENCE BOOK:

1. Cp Baveja, "Textbook of Microbiology", Arya Publications

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Subject Code: BBE19007	Subject Name: MEDICAL RADIOLOGICAL HEALTH ENGINEERING		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:		T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To introduce RF and Microwave Radiation
- To impart knowledge on **radiation** detection and measurement
- To educate on radiation safety in nuclear medicine and radiotherapy.
- To introduce the laser and ultraviolet radiation safety.
- To introduce **monitoring** and internal dosimetry

COURSE OUTCOMES (COs) : (3- 5)

CO1	Ability to analyze RF and Microwave Radiation
CO2	Ability to apply radiation detection and measurement
CO3	Ability to analyze radiation safety in nuclear medicine and radiotherapy
CO4	Gain knowledge on thelaser and ultraviolet radiation safety
CO5	Understands the concept of monitoring and internal dosimetry

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	l	L	H	M	L	H	H	H	M	L	H	H
CO2	H	M	M	H	H	L	H	L	H	M	H	H
CO3	M	M	H	H	L	L	H	L	M	L	M	M
CO4	M	M	M	L	L	M	L	L	L	L	L	M
CO5	H	L	H	M	H	M	L	M	L	M	M	L
COs / PSOs	PSO1		PSO2		PSO3		PSO4		PSO5			
CO1	M		H		L		M		L			
CO2	L		H		H		H		M			
CO3	H		L		H		H		L			
CO4	L		L		H		H		M			
CO5	M		M		L		L		M			

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
		✓										

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UNIT I   INTRODUCTION TO RF AND MICROWAVE RADIATION   9

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

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

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

Classification of UV radiation -Sources of UV- Biological effects of UV- Hazards associated with UV radiation- UV control measures - Safety management of UVClassifications of LASER and its radiation hazards- control measures- Emergencies and incident procedures.

UNIT V   MONITORING AND INTERNAL DOSIMETRY   9

Monitoring methods-personal radiation monitoring- Records of personal dosimetryICRP method- MIRD method- Internal doses from radiopharmaceuticals- Bioassay of radioactivity-Hazard and risk in radiation protection- radiological incidents and emergencies- Regulation to radiation protection.

Total No of Periods: 45

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 and Hodder Arnold- "An introduction to radiation protection", 6 th edition, 2012

REFERENCE BOOKS:

1. Max Hlombardi, "Radiation safety in nuclear medicine", CRC Press Taylor &Francis group, 2nd edition, 2007
2. Aruna Kaushik, Anupam mondal, B.S. Dwarakanath, andR.P.Tripathi, "Radiation protection manual"- INMAS- DRDO,2010

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Subject Code: BBE19ET1	Subject Name: BIO-REACTION ENGINEERING AND DESIGN		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:		ETL	1	0/1	3/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To make the student demonstrate fermentation process
- To impart knowledge on design for fermentation process.
- To impart knowledge on **sterilization** kinetics
- To educate on characteristicsof metabolic stoichiometry and energetics.
- To introduce the phenomenon of rectifiers.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Ability to analyze functioningof fermentation process
CO2	Ability to study for fermentation process
CO3	Ability to study sterilization kinetics.
CO4	Gain knowledge aboutthe phenomenon ofmetabolic stoichiometry and energetics
CO5	Understands the concept of phenomenon of rectifiers

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	L	H	M	H	M	L	M	H
CO2	M	H	M	M	H	M	H	M	H	M	H	H
CO3	H	H	H	H	M	M	H	M	H	L	M	H
CO4	M	H	L	M	H	M	H	M	H	M	L	M
CO5	H	M	H	M	H	M	L	M	H	L	M	M

COs / PSOs	PSO1	PSO2	PSO3			
CO1	H	H	M			
CO2	M	H	M			
CO3	H	M	H			
CO4	M	M	H			
CO5	M	M	L			

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

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BBE19ET1   **BIO-REACTION ENGINEERING AND DESIGN**   1   0/1   3/0   3

UNIT I   OVERVIEW OF FERMENTATION PROCESSES   9

Overview of fermentation industry- general requirements of fermentation processes- basicconfiguration of fermenter and ancillaries- main parameters to be monitored and controlledin fermentation processes.

UNIT II   RAW MATERIALS AND MEDIA DESIGN FOR FERMENTATIONPROCESS   9

Criteria for good medium- medium requirements for fermentation processes- carbon-nitrogen- minerals- vitamins and other complex nutrients- oxygen requirements. Mediumformulation for optimal growth and product formation- examples of simple and complexmedia- design of various commercial media for industrial fermentations- mediumoptimization methods.

UNIT III   STERILIZATION KINETICS   9

Thermal death kinetics of microorganisms- batch and continuous heat sterilization ofliquid media- filter sterilization of liquid media- air sterilization and design of sterilizationequipment - batch and continuous.

UNIT IV   METABOLIC STOICHIOMETRY AND ENERGETICS   9

Stoichiometry of cell growth and product formation- elemental balances- degrees ofreduction of substrate and biomass- available electron balances- yield coefficients ofbiomass and product formation- maintenance coefficients- energetic analysis of microbialgrowth and product formation- oxygen consumption and heat evolution in aerobic cultures-thermodynamic efficiency of growth.

UNIT V   KINETICS OF MICROBIAL GROWTH AND PRODUCTFORMATION   9

Batch cultivation and continuous cultivation. Simple unstructured models for microbial growth- Monod model- growth of filamentous organisms- product formation kinetics – Leudeking-Piret models- substrate and product inhibition on cell growth and product formation. Biomass estimation - Direct and Indirect methods.

Total No of Periods: 45

TEXT BOOKS:
1. Shuler- Michael L. and FikretKargi, "Bioprocess Engineering", Prentice Hall, 1992.
2. Doran M Pauline "Bioprocess Engineering Principles", 2 nd Edition, Elsevier, 2012.
3. GhasemD.Najafpour, "Biochemical Engineering and Biotechnology", Elsevier, 2007.

REFERENCE BOOKS:
1. Bailey- James E. and David F. Ollis,"Biochemical Engineering Fundamentals", 2nd Edition. McGraw Hill, 1986.
2. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology- Science & Technology Books, 1995.
3. Jens Nielson, John Villadsen and Gunnar Liden, "Bioreaction engineering principles",2nd Edition-Kulwer Academic, 2002
4. Tapobrate Panda, "Bioreactors: Analysis and Design", Tata McGraw Hill, 2011
5. Rajiv Dutta, "Fundamentals of Biochemical Engineering"- Springer, 2008

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Subject Code: BBE19L03	Subject Name: BIOMEDICAL ELECTRONICS LAB – II	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	T	0	0/0	3/0	1

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To make the student demonstrate the functioning of voltage regulators
- To impart knowledge on multivibrators.
- To impart knowledge on functioning of logic circuits
- To educate on characteristics of encoders-decoders- multiplexers and demultiplexers.
- To introduce the phenomenon of synchronous and asynchronous counters.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Ability to analyze functioningof voltage regulators
CO2	Ability to studymultivibrators
CO3	Ability to studyintroduction to logic circuits.
CO4	Gain knowledge aboutthe phenomenon of encoders-decoders- multiplexers and demultiplexers
CO5	Understands the concept of synchronous and asynchronous counters

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	L	H	M	H	M	L	M	H
CO2	M	H	M	L	H	M	H	M	H	M	H	H
CO3	L	H	H	H	M	L	H	M	H	L	M	H
CO4	M	H	L	M	H	M	L	M	H	M	L	L
CO5	L	M	H	M	H	M	L	M	H	L	M	L

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	M
CO2	M	H	M
CO3	H	M	H
CO4	M	M	H
CO5	M	M	L

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					

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BBE19L03   **BIOMEDICAL ELECTRONICS LAB –II**   0   0/0   3/0   1

LIST OF EXPERIMENTS

1. Design of Series voltage regulators
2. Design of Shunt voltage regulators.
3. Design of Tuned amplifiers
4. Design of Astablemultivibrators
5. Design of Monostable multivibrators
6. Design of UJT relaxation oscillator
7. Study of logic gates
8. Verification of Boolean expression
6. Design of adders using logic gates
7. Design of subtractors using logic gates
8. Design of Multiplexer using logic gates
9. Design of Demultiplexer using logic gates
10. Design of encoder using logic gates
11. Design of decoder using logic gates
12. Design of Flip flops using logic gates
13. Design of magnitude comparator using logic gates
14. Design of asynchronous counters
15. Design of synchronous counters

Total No of Periods: 45

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Subject Code: BBE19L04	Subject Name: BIOMEDICAL ENGINEERING LAB – I	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	T	0	0/0	3/0	1

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To make the student demonstrate the functioning of transducers
- To impart knowledge on Electrodes.
- To impart knowledge onfunctioning of Amplifiers
- To educate on characteristics of special transducers.
- To introduce the phenomenon of Audiometer.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Ability to analyze functioningof transducers
CO2	Ability to studyon Electrodes.
CO3	Ability to study introduction to functioning of Amplifiers.
CO4	Gain knowledge aboutthe phenomenon of special transducers
CO5	Understands the concept of Audiometer.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	L	H	M	H	M	L	M	H
CO2	M	H	M	L	H	M	H	M	H	M	H	H
CO3	L	H	H	H	M	L	H	M	H	L	M	H
CO4	M	H	L	M	H	M	L	M	H	M	L	L
CO5	L	M	H	M	H	M	L	M	H	L	M	L

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	M
CO2	M	H	M
CO3	H	M	H
CO4	M	M	H
CO5	M	M	L

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					

BBE19L04   **BIOMEDICAL ENGINEERING LAB – I**   0   0/0   3/0   1

LIST OF EXPERIMENTS

1. Measurement of strain using strain gauge for Quarter bridge
2. Measurement of strain using strain gauge for Half bridge
3. Measurement of strain using strain gauge for Full bridge
4. Plotting characteristics of Photoelectric Transducer in medical equipment's
5. Plotting characteristics of Temperature Transducer in medical equipment's
6. Plotting characteristics of Piezo-electric Transducer in medical equipment's
7. Plotting characteristics of Thermoelectric Transducer.
8. Determination of characteristics of Polarized Electrodes-
9. Determination of characteristics of Non-polarized Electrodes
10. Determination of characteristics of Multi Point Electrodes.
11. Determination of characteristics of DC Amplifier in medical equipment's
12. Determination of characteristics of Chopper Amplifier in medical equipment's
13. Determination of characteristics of Instrumentation Amplifier in medical equipment's
14. Characteristics of Ultrasound Transducer in fetal monitoring
15. Characteristics of Phono Transducer.
16. Measurement of Hearing Threshold using Audiometer and plotting its characteristics.

Total No of Periods: 45

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Subject Code: BBE19TS1	Subject Name: TECHNICAL SKILL I	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	L	0	0/0	3/0	1

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : The objective is to develop the technical skill of the students.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Develop the technical skills required in the field of study
CO2	Bridge the gap between the skill requirements of the employer or industry and the competency of the students.
CO3	Enhance the employability of the students.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	M	M	H	M	H	M
CO2	H	H	M	H	H	H	M	M	H	H	H	H
CO3	H	H	H	H	H	H	M	M	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3			
CO1	H	H	H			
CO2	H	H	H			
CO3	H	H	H			

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
								✓				

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Subject Code: BEN18SK1	Subject Name: SOFT SKILLS – I (CAREER AND CONFIDENCE BUILDING)	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	ETL	1	0/0	3/0	1

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To create awareness in students- various top companies helping them improve their skill set matrix- leading to develop a positive frame of mind.
- To help students be aware of various techniques of candidate recruitment and help them prepare CV's and resume.
- To help student how to face various types of interview- preparing for HR- technical interviews.
- To help students improve their verbal reading- narration and presentation skills by performs various mock sessions.

COURSE OUTCOMES (COs) : (3- 5) Students will be able to

CO1	Be aware of various top companies leading to improvement in skills amongst them.
CO2	Be aware of various candidate recruitment techniques like group discussion- interviews and be able to prepare CV's and resumes.
CO3	Prepare for different types of interviews and be prepared for HR and technical interviews.
CO4	Improve their verbal- written and other skills by performing mock sessions.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L	L	L	M	M	H	M	H	M	H
CO2	L	L	L	L	L	M	M	H	M	H	M	H
CO3	L	L	L	L	L	M	M	H	M	H	M	H
CO4	L	L	L	L	L	M	M	H	M	H	M	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	L	L	H	L	L			
CO2	L	L	H	L	L			
CO3	L	L	H	L	L			
CO4	L	L	H	L	L			

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
			✓						✓			

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BEN18SK1	SOFT SKILLS – I(CAREER AND CONFIDENCE BUILDING)	1	0/0	3/0	1

UNIT I   **6**
Creation of awareness of top companies / improving skill set matrix / Development of positive frame of mind / Creation of self-awareness

UNIT II   **6**
Group discussions / Do's and don'ts – handling group discussions / what evaluators look for interpersonal relationships / Preparation of Curriculum Vitae / Resume

UNIT III   **6**
Interview – awareness of facing questions – Do's and don'ts of personal interview / group interview, enabling students to prepare for different proce3dures such as HR interviews and Technical Interviews / self-introductions

UNIT IV   **6**
Verbal aptitude, Reading comprehension / narration / presentation / Mock Interviews

UNIT V   **6**
Practical session on Group Discussion and written tests on vocabulary and reading comprehension

Total No of Periods: 30

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Subject Code: BBE19008	Subject Name: BIO CONTROL ENGINEERING		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None		T	3	1/0	0/0	4

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To provide strong foundation in basic science and mathematics necessary to formulate-solve and analyze control and instrumentation problems
- To solve control and instrumentation problems
- To analyze control and instrumentation problems
- To understand and apply differential equation-integrals-matrix theory- probability theory etc
- To provide good knowledge of instrumentation systems and their applications

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understands strong foundation in basic science and mathematics necessary to formulate-solve and analyze control and instrumentation problems
CO2	Capable to solve control and instrumentation problems
CO3	Capable to analyze control and instrumentation problems
CO4	Understands and applies differential equation-integrals-matrix theory-probability theoryetc
CO5	Familiarized with good knowledge of instrumentation systems and their applications

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	M	H	M	L	L	M	H	L	H	M
CO2	M	H	L	M	H	L	M	H	L	M	H	M
CO3	H	M	L	H	M	L	H	M	L	H	M	L
CO4	M	H	M	L	M	H	L	M	H	L	M	H
CO5	M	H	L	M	H	L	M	H	L	M	H	L

COs / PSOs	PSO1	PSO2	PSO3
CO1	M	H	L
CO2	H	M	L
CO3	M	H	M
CO4	H	M	L
CO5	H	M	L

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

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| BBE19008 | BIO CONTROL ENGINEERING | 3 | 1/0 | 0/0 | 4 |

UNIT I CONTROL SYSTEM MODELING 12

System concept- Differential Equations- Transfer functions- modeling of electrical systems- Translational and rotational mechanical systems-physiological systems- block diagram modeling- signal flow graphs.

UNIT II TIME RESPONSE ANALYSIS 12

Time domain specifications-step and Impulse response analysis of first order and second order systems-steady state errors- Root locus techniques- construction of root locus- dominant poles- applications of Root locus diagram.

UNIT III FREQUENCY RESPONSE& STABILITY ANALYSIS 12

Frequency response- Bode plot-Nyquist plots- Nyquist stability criterion- Relative stability- Gain margin-phase margin- bandwidth magnitude plots- constant circles- Nichol's chart – stability- Routh-Hurwitz criteria.

UNIT IV PHYSIOLOGICAL CONTROL SYSTEMS 12

Introduction to physiological control systems- modeling of human movements- parameter estimation-linearizing.

UNIT V STUDY OF BIOLOGICAL SYSTEMS 12

Human Thermal system- Neuro muscular system- Respiratory system- occulomotor system.

Total Number of Periods: 60

TEXT BOOKS:
1. M.Gopal, "Control Systems"- Principles and Design, Tata McGrawHill, 1997.
2. Benjamin. C.Kuo, "Automatic Control Systems", Prentice Hall of India, 1995

REFERENCE BOOKS:

1. Manfreclyner and John H.Milsum,"Bio Medical engineering system", McGraw-Hill and Co., New York, 1970.

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Subject Code: BBE19009	Subject Name :SENSORS AND MEASURING TECHNIQUES	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To study about the science of measurement
- To impart knowledge on displacement- pressure- temperature sensors
- To educate on photoelectric and piezo electric sensors
- To introduce the signal conditioning circuits
- To introduce display and recording devices

COURSE OUTCOMES (COs) : (3- 5)

CO1	Ability to study about the science of measurement
CO2	Ability to acquire knowledge on displacement- pressure- temperature sensors
CO3	Ability to understand photoelectric and piezo electric sensors
CO4	Gain knowledge about the phenomenon of signal conditioning circuits
CO5	Understands the concept of display and recording devices

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	L	H	M	H	M	L	M	H
CO2	M	H	M	L	H	M	H	M	H	M	H	H
CO3	L	H	H	H	M	L	H	M	H	L	M	H
CO4	M	H	L	M	H	M	L	M	H	M	L	L
CO5	L	M	H	M	H	M	L	M	H	L	M	L

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	M
CO2	M	H	M
CO3	H	M	H
CO4	M	M	H
CO5	M	M	M

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
		✓										

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BBE19009	SENSORS AND MEASURING TECHNIQUES	3	0/0	0/0	3

UNIT I   SCIENCE OF MEASUREMENT   9

Measurement System – Instrumentation - Classification and Characteristics of Transducers - Static and Dynamic - Errors in Measurements and their statistical analysis – Calibration - Primary and secondary standards.

UNIT II   DISPLACEMENT- PRESSURE- TEMPERATURE SENSORS   9

Strain Gauge: Gauge factor- sensing elements- configuration- and unbounded strain gage. Capacitive transducer - various arrangements- Inductive transducer- LVDT- Passive types: RTD materials & range-relative resistance vs. temperature characteristics- thermistor characteristics- Active type: Thermocouple - characteristics.

UNIT III   PHOTOELECTRIC AND PIEZO ELECTRIC SENSORS   9

Phototube- scintillation counter- photo multiplier tube (PMT)- photovoltaic- photo conductive cells-photo diodes- phototransistor- comparison of photoelectric transducers. Optical displacement sensors and optical encoders. Piezoelectric active transducer- Equivalent circuit and its characteristics.

UNIT IV   SIGNAL CONDITIONING CIRCUITS   9

 Functions of signal conditioning circuits- Preamplifiers- Concepts of passive filters- Impedance matching circuits- AC and DC Bridges - wheat stone bridge- Kelvin- Maxwell- Hay- Schering

UNIT V   DISPLAY AND RECORDING DEVICES   9

Digital voltmeter – Multi meter – CRO – block diagram- CRT – vertical & horizontal deflection system- DSO- LCD monitor- PMMC writing systems- servo recorders- photographic recorder- magnetic tape recorder- Inkjet recorder- thermal recorder.

Total No of Periods: 45

TEXT BOOKS:

1. A.K.Sawhney, "Electrical & Electronics Measurement and Instrumentation‖", 10thedition,DhanpatRai& Co., New Delhi, 19th Revised edition 2011, Reprint 2014.
2. John G. Webster, "Medical Instrumentation Application and Design‖", 4th edition, Wiley India Pvt Ltd-New Delhi, 2015.

REFERENCE BOOKS:

1. Ernest O Doebelin and Dhanesh N Manik,"Measurement systems", Application and design, 6th edition, McGraw-Hill, 2012.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation‖", 3rdedition-Tata McGraw-Hill, New Delhi, 2014.

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Subject Code: BBE19ET2	Subject Name: BIOMEDICAL SIGNALS AND SYSTEMS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	ETL	1	0/1	3/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To study and analyze the continuous and discrete-time signals and systems- their properties.
- To have Knowledge of time-domain representation and analysis concepts.
- To familiarize the concepts of frequency-domain representation and analysis using Fourier Analysis tools.
- To understand the concepts of the sampling process and to identify and solve engineering problems
- To analyze the systems by examining their input and output signals.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Ability to analyze signals and systems.
CO2	Ability to apply circuit theorems
CO3	Ability to analyzefrequency domain and Fourier Analysis- Z transform.
CO4	Gain knowledge about the concept of sampling process.
CO5	Understands the concept of input and output signal.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	L	H	M	H	M	L	M	H
CO2	M	H	M	L	H	M	H	M	H	M	H	H
CO3	L	H	H	H	M	L	H	M	H	L	M	H
CO4	M	H	L	M	H	M	L	M	H	M	L	M
CO5	L	M	H	M	H	M	L	M	H	M	M	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	M	M	L
CO2	M	H	M	L	M
CO3	H	M	H	L	L
CO4	M	M	H	L	H
CO5	M	M	L	L	H

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

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BBE19ET2   **BIOMEDICAL SIGNALS AND SYSTEMS**   **1**   **0/1**   **3/0**   **3**

UNIT I   CLASSIFICATION OF SIGNALS AND SYSTEMS   9

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   9

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   CONTINUOUS TIME SYSTEMS   9

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   9

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

UNIT V   DISCRETE TIME SYSTEMS   9

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

Total No of Periods: 45

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, Second edition, 2004

REFERENCE BOOKS:

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

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Subject Code: BBE19L06	Subject Name: BIOMEDICAL ENGINEERING LAB – II	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	T	0	0/0	3/0	1

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To make the student demonstrate the basic concepts of bio-signals
- To impart knowledge on DFT.
- To impart knowledge on functioning of FIR- IIR filters
- To educate on characteristics of BP and its related parameters.
- To introduce the phenomenon of Cardiac related measurements.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Ability to analyze functioningof bio-signals
CO2	Ability to study ofDFT
CO3	Ability to study introduction to functioning of FIR- IIR filters
CO4	Gain knowledge aboutthe phenomenon of BP and its related parameters
CO5	Understands the concept Cardiac related measurements.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	L	H	M	H	M	L	M	H
CO2	M	H	M	L	H	M	H	M	H	M	H	H
CO3	L	H	H	H	M	L	H	M	H	L	M	H
CO4	M	H	L	M	H	M	L	M	H	M	L	L
CO5	L	M	H	M	H	M	L	M	H	L	M	L

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	M
CO2	M	H	M
CO3	H	M	H
CO4	M	M	H
CO5	M	M	L

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					

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BBE19L06   **BIOMEDICAL ENGINEERING LAB – II**   0   0/0   3/0   1

LIST OF EXPERIMENTS

1. Generation of original sequence along with operation on sequence like shifting- folding- time scaling and multiplication for any Bio-signals.
2. Generation of Periodic- Exponential- Sinusoidal- Damped sinusoidal- Step- Impulse- Ramp signals using MATLAB in both discrete and analog form of Bio-signals
3. Evaluation of convolution of Bio-signals using simulation
4. Evaluation of CFT of Bio-signals using simulation
5. Evaluation of DFT of Bio-signals using simulation
6. Evaluation of differential equations using MATLAB
7. Characteristics of FIR filters in processing Bio-signals
8. Characteristics of IIR filters in processing Bio-signals
9. Determination of Cross correlation and auto correlation of Bio-signals
10. Implementation of Multirate signal processing concepts.
11. Determination of Heart Axis by measuring QRS amplitude in the different leads
12. Plotting of Einthovin Triangle.
13. Recording of blood pressure using sphygmomanometer & stethoscope
14. Estimation of Variance in BP
15. Measurements of various time intervals between each segment of ECG
16. Measurement of R-R interval and calculation of Heart Rate
17. Cardiac Efficiency Test

Total No of Periods: 45

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Subject Code: BBE19L07	Subject Name: BIO-CONTROL ENGINEERING LAB	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	L	0	0/0	3/0	1

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- ➢ To understand the standard systems and its responses
- ➢ To analyze the stability
- ➢ To get plotting of various frequency responses

COURSE OUTCOMES (COs): (3- 5)

CO1	Understandsthe standard systems and its responses
CO2	Capable to analyze the stability
CO3	Capable to obtain the plotting of various frequency responses

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	L	H	M	L	M	H	L	L
CO2	M	H	M	H	L	M	L	L	M	M	H	H
CO3	H	M	H	M	H	L	H	L	M	M	H	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	M	L
CO2	M	M	H
CO3	H	M	M

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					

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BBE19L07   BIO-CONTROL ENGINEERING LAB   0   0/0   3/0   1

LIST OF EXPERIMENTS

1. a) Step- ramp and Impulse response of first order systems.
    b) Step- ramp and Impulse response of second order systems.
2. Identification of damping in second order systems.
3. Time domain analysis for second order systems
4. Stability analysis of linear systems using Routh-Hurwitz method
5. Stability analysis of linear systems using Root Locus.
6. Frequency response analysis using Bode Plot.
7. Frequency response analysis using Polar Plot
8. Design of PID Controller for first order and second order systems.
9. Design of PID Controller for speed control of DC Motor System.
10. Design of PID Based controller for Twin Rotor Multi Input Multi Output System.
11. Design a controller for ECG Wave form
12. Design a controller for EEG Wave form
13. Design a controller for EMG Wave form

Total No of Periods:45

Subject Code: BBE19L08	Subject Name: SENSORS AND MEASUREMENTS LAB	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	L	0	0/0	3/0	1

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- ➢ To understand the characteristics of Instruments.
- ➢ To analyze the various recorders

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understandsthe characteristics of Instruments.
CO2	Capable to analyze the various recorders

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	L	H	M	L	M	H	L	L
CO2	M	H	M	H	L	- M	L	L	M	M	H	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	M	L
CO2	M	M	H

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					

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BBE19L08	SENSORS AND MEASUREMENT	0	0/0	3/0	1
	LAB				

LIST OF EXPERIMENTS

1. Characteristics of strain gauges.
2. Displacement measurement using LVDT.
3. Characteristics of temperature sensors – thermistor
4. Characteristics of Temperature Sensor - RTD
5. Characteristics of thermocouple
6. Characteristics of Piezoelectric Transducer.
7. Study of Anderson bridge
8. Study of Schering Bridge
9. Study of Wheat Stone Bridge
10. Study of Kelvin Bridge.
11. Isolation amplifier.
12. Study of Medical Oscilloscope.
13. Study of Input / Output characteristics using X – Y oscilloscope and X Recorders.
14. Calculation of spectral response of bio signal- using spectrum analyze.
15. Study of Hall effect Transducer

Total No of Periods:45

Subject Code: BBE19TS2	Subject Name: TECHNICAL SKILL II	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: TECHNICAL SKILL I	0	0	0/0	3/0	1

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : The objective is to develop the technical skill of the students.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Develop the technical skills required in the field of study
CO2	Bridge the gap between the skill requirements of the employer or industry and the competency of the students.
CO3	Enhance the employability of the students.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	M	M	H	M	H	M
CO2	H	H	M	H	H	H	M	M	H	H	H	H
CO3	H	H	H	H	H	H	M	M	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3		
CO1	H	H	H		
CO2	H	H	H		
CO3	H	H	H		

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
								✓				

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Subject Code: BBE19010	Subject Name: REHABILITATION ENGINEERING AND ASSISTIVE TECHNOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	T	3	1/0	0/0	4

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To study basics of Rehabilitation Engineering
- To learn the design of Wheel Chairs
- To gain knowledge of the recent developments in the field of rehabilitation engineering.
- To understand various assistive technology for vision and hearing
- To study various orthotic and prosthetic devices

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understands the basics of Rehabilitation Engineering
CO2	Capable to design Wheel Chairs
CO3	Understands the recent developments in the field of rehabilitation engineering
CO4	Acquires various assistive technology
CO5	Analysis Various Assistive Orthopedic Prosthetics & Application

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	H	L	M	H	L	M	H	H	H
CO2	H	M	H	M	L	M	H	L	M	H	L	M
CO3	H	M	H	M	L	M	H	H	M	H	L	M
CO4	L	H	M	L	H	M	H	L	L	H	M	H
CO5	M	H	L	H	M	L	H	L	M	H	L	M

COs / PSOs	PSO1	PSO2	PSO3
CO1	M	H	L
CO2	M	L	H
CO3	H	L	M
CO4	L	M	M
CO5	H	M	L

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

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BBE19010	REHABILITATION ENGINEERING AND ASSISTIVE TECHNOLOGY	3	1/0	0/0	4

UNIT I   REHABILITATION TECHNOLOGY&SCIENCE   12

Selection-design or manufacturing of augmentive or assistive devices appropriate for individual with disability- Knowledge about the basic and clinical research about the variation in the physiological functioning and anatomical structure

UNIT II   REHABILITATION   ADVOCACY&MEDICINE   12

Legal aspect helps the handicapped people in choosing the devices-the provisions available to them in this regard- Physiological aspects of functional recovery-neurological and physiological aspects-rehabilitation therapies training to restore vision auditory and speech

UNIT III   REHABILITATION   ENGINEERING   12

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 IV   ASSISTIVE TECHNOLOGY   12

Principles of Assistive Technology Assessment- Key Engineering Principles- Key Ergonomic Principles - Practice of Rehabilitation and Assistive Technology

UNIT V   ASSISTIVE ORTHOPEDIC PROSTHETICS & APPLICATION   12

hierarchically controlled Prosthetic Hand- Myoelectric hand and arm prosthesis – block diagram- signal flow diagram and functions- Specific Impairments and Related technologies- Future Developments – Rehabilitation Robotics- and Brain computer interface systems.

Total No of Periods: 60

TEXT BOOKS:
1. Keswick.J, "What is Rehabilitation Engineering? Annual Review of rehabilitation", volume 2 springer, New York, 1982.
2. Sunder,""Textbook of Rehabilitation", Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi, 2nd Edition, Reprint, 2007

REFERENCE BOOKS:
1. Robinsion.C.J,"Rehabilitation Engineering Handbook of electrical engineering", CRC Press Bocaraton, 1993.

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Subject Code: BBE19011	Subject Name: BIOTRANSPORT PROCESS		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:		T	3	1/0	0/0	4

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- ➢ To gain knowledge on fundamental concepts in bio transport
- ➢ To study about biofluid transport
- ➢ To learn about bioheat transport
- ➢ To gain knowledge on biological mass transport

COURSE OUTCOMES (COs) : (3- 5)

CO1	Capable to analyze fundamental concepts in bio transport
CO2	Understands biofluid transport
CO3	Acquire the knowledge aboutbioheat transport
CO4	Ability to analyze biological mass transport
CO5	Capable to learn about approaches to various bio transport

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	L	H	M	H	H	H	L	L	M	H
CO2	H	M	M	M	M	H	H	H	M	L	L	M
CO3	H	H	H	M	H	L	M	H	M	M	H	L
CO4	M	H	L	M	L	H	H	M	H	L	H	L
CO5	H	M	H	M	L	H	L	M	L	L	M	L

COs / PSOs	PSO1	PSO2	PSO3									
CO1	H	M	M									
CO2	M	M	L									
CO3	M	H	H									
CO4	H	H	M									
CO5	H	H	M									

H/M/L indicates Strength of Correlation   H- High- M- Medium- L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

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| BBE19011 | BIOTRANSPORT PROCESS | 3 | 1/0 | 0/0 | 4 |

UNIT I   FUNDAMENTAL CONCEPTS IN BIOTRANSPORT   12

Fundamental Concepts in Biotransport-The System and Its Environment-Transport Scales in Time and Space-Continuum Concepts-Conservation Principles-Transport Mechanisms-Molecular Transport Mechanisms-Convective Transport Mechanisms-Macroscopic Transport Coefficients-Interphase Transport -Transport in Biological Systems

UNIT II   BIOFLUID TRANSPORT   12

Rheology of Biological - Solids and Fluids - Flow Regimes: Laminar and Turbulent - Boundary Conditions-Viscous Properties of Fluids - Viscous Momentum Flux and Shear Stress --Newtonian and Non-Newtonian Fluid - Newtonian Fluid Model - Non-Newtonian Fluid -Identification of Constitutive Model Equations - Rheological Properties of Extravascular Body - Blood Rheology -Biorheology and Disease.

UNIT III   BIOHEAT TRANSPORT   12

Heat Transfer Fundamentalsc-onvection- Four Principle Characteristics of Convective Processes-Fundamentals of Convective Processes - Forced Convection Analysis-Free Convection Processes - Thermal Resistance in Convection -Biot Number-Thermal Radiation -Three Governing Characteristics of Thermal Radiation Processes - The Role of Surface Properties in Thermal Radiation - The Role of Geometric Sizes- Shapes- Separation- and Orientation in Thermal Radiation - Electrical Resistance Model for Radiation- Common Heat Transfer Boundary Conditions

UNIT IV   BIOLOGICAL MASS TRANSPORT   12

Average and Local Mass and Molar Concentrations-Phase Equilibrium-Liquid–Gas Equilibrium-Liquid–Liquid- Gas–Solid- Liquid–Solid- Solid–Solid Equilibrium -Species Transport Between Phases-Diffusion Fluxes and Velocities-Convective and Diffusive Transport-Molecular Diffusion and Fick's Law of Diffusion -Mass Transfer Coefficients-Comparison of Internal and External Resistances to Mass Transfer -Hemoglobin and Blood Oxygen Transport .- Blood CO_2 Transport and pH - Cellular Transport Mechanisms -Carrier-Mediated Transport-Active Transport

UNIT V   APPROACHES TO VARIOUS BIOTRANSPORT   12

Macroscopic Approach- Shell Balance Approach- General Microscopic Approach of Biofluid- Bioheat-Biomass

Total No of Periods: 60

TEXT BOOKS:

1. Robert J. Roselli l Kenneth R. Diller,"Biotransport: Principles and Applications", ISBN 978-1-4419-8118-9 e-ISBN 978-1-4419-8119-6 DOI 10.1007/978-1-4419-8119-6 Springer New York Dordrecht Heidelberg London.

REFERENCE BOOKS:

1. https://link.springer.com/content/pdf/bfm%3A978-1-4419-8119-6%2F1.pdf

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Subject Code: BBE19ET3	Subject Name : COMPUTATIONAL MODELING OF BIOLOGICAL TISSUES	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	ETL	1	0/1	3/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- ➢ To gain knowledge on introduction of computational modeling of biological tissues
- ➢ To study about visualization of computational modeling of biological tissues
- ➢ To learn about IDLof computational modeling of biological tissues
- ➢ To gain knowledge on formulationIof computational modeling of biological tissues
- ➢ To learn about formulationII of computational modeling of biological tissues

COURSE OUTCOMES (COs) : (3- 5)

CO1	Capable to understand introduction of computational modeling of biological tissues
CO2	Understands visualization of computational modeling of biological tissues
CO3	Acquire the knowledge about IDLof computational modeling of biological tissues
CO4	Ability to analyze formulationIof computational modeling of biological tissues
CO5	Capable to analyze formulationII of computational modeling of biological tissues

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	L	H	M	H	H	H	L	L	M	H
CO2	M	M	M	M	H	H	H	H	M	L	L	M
CO3	H	H	H	M	H	L	M	H	H	H	M	L
CO4	M	H	L	M	M	H	L	M	M	L	H	L
CO5	H	M	H	M	H	H	M	M	H	L	M	L

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	M	L
CO2	M	M	L
CO3	M	H	L
CO4	H	H	M
CO5	M	M	H

H/M/L indicates Strength of Correlation   H- High- M- Medium- L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

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BBE19ET3 COMPUTATIONAL MODELING OF BIOLOGICAL TISSUES 1 0/1 3/0 3

UNIT I INTRODUCTION 9
Modeling Classifications of Biological Tissues-Computational Modeling Paradigm in Biomedical Field-A Simple Modeling Example in real field.

UNIT II TISSUE ENGINEERING 9

Skin tissue engineering -Bone and cartilage tissue engineering - Cardiac tissue engineering - Valve tissue engineering - Vascular tissue engineering - Neural tissue engineering - Visceral tissue engineering - Organ and tissue transplantation -Scaffold design and fabrication.

UNIT III IDL and VISUALIZATION 9
Representing topologies- Visualizing Topology- Introduction to IDL for Visualization- Creating Graphical User Interfaces (GUI) for Visualization- Widget Programming in IDL – Basic Overview of Steps from Image to Unstructured or Structured Mesh Generation

UNIT IV FORMULATIONI 9
Finite Element Formulation for Potential Problems (Electrical Conduction- Heat Conduction- Fluid Flow Through Porous Media)-Homogenization Formulation for the Multilevel Potential Problem-Homogenization Formulation for the Multilevel Diffusion Problem- Finite Element Formulation for Small Deformation Elasticity- Homogenization Formulation for Small Deformation Elasticity

UNIT V FORMULATION II 9

Computational Simulation of Bone Adaptation-Homogenization Formulation for Fluid Flow through Porous Tissue- Nonlinear Analysis Preliminary: Stress- Strain and Constitutive Defintions-Finite Element Formulation for Nonlinear Hyperelastic Material undergoing Large Deformation

Total No of Periods: 45

TEXT BOOKS:

1. Nikolay V Dokholyan-Computational Modeling of Biological Systems: From Molecules to Pathways (Biological and Medical Physics- Biomedical Engineering) 2012th EditionISBN-13: 978-1489987501ISBN-10: 1489987509 Springer

REFERENCE BOOKS:

1. https://www.researchgate.net/publication/267865119_Computational_modeling_of_soft_tissues_and_ligaments

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Subject Code: BBE19L10	Subject Name :BIOMEDICAL ENGINEERING LAB -III	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	L	0	0/0	3/0	1

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- ➤ To understand the standard operating procedures of various biomedical equipment's
- ➤ To analyze the different biological system using the biomedical equipment's

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understands the standard operating procedures of various biomedical equipment's
CO2	Capable to analyze the different biological system using the biomedical equipment's

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	L	H	M	L	M	H	L	L
CO2	M	H	M	H	L	- M	L	L	M	M	H	H
COs / PSOs	PSO1		PSO2		PSO3							
CO1	H		M		L							
CO2	M		M		H							

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					

BBE19L10   **BIOMEDICAL ENGINEERING LAB -III**   0   0/0   3/0   1

LIST OF EXPERIMENTS

1. Real time monitoring of Echocardiography
2. Real time patient monitoring system
3. Respiratory system analysis using Spirometer
4. Analysis of ECG abnormal wave pattern using Arrhythmia Simulator
5. EEG wave analysis using simulator
6. ECG wave analysis using simulator
7. Ultrasound blood flow measurement to identify arteries and veins
8. Auditory system checkup using Audiometer
9. Troubleshooting of defibrillator
10. Troubleshooting of pulse oximeter
11. Demonstration of bedside monitor
12. Demonstrate multipara monitor
13. Biotelemetry
14. Pacemaker Module

Total No of Periods: 45

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Subject Code: BEN18SK2	Subject Name : SOFT SKILLS – II (Qualitative and Quantitative Skills)	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Soft Skills - I	ETL	0	0/0	3/0	1

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : The main objective is to strengthen the logical and arithmetic reasoning skills of the students.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Recognize and apply arithmetic knowledge in a variety of contexts.
CO2	Ability to identify and critically evaluate philosophical arguments and defend them from criticism.
CO3	Define data and interpret information from graphs.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	L	L	H	M	H	H
CO2	M	M	M	H	L	H	L	H	H	H	H	L
CO3	H	H	H	H	H	H	M	M	H	H	H	H

COs / PSOs	PSO1		PSO2		PSO3							
CO1	H		H		M							
CO2	M		M		H							

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
									✓			

**BEN18SK2   SOFT SKILLS – II(Qualitative and Quantitative   0   0/0   3/0   1
Skills)**

UNIT I   LOGICAL REASONING I   6
Logical Statements – Arguments – Assumptions – Courses of Action

UNIT II   LOGICAL REASONING II   6
Logical conclusions – Deriving conclusions from passages – Theme detection

UNIT III   ARITHMETICAL REASONING I   6
Number system – H.C.F and L.C.M – Problem on ages – Percentage – Profit and Loss – Ratio and
Proportion – Partnership

UNIT IV   ARITHMETICAL REASONING II   6
Time and Work – Time and Distance – Clocks – Permutations and Combinations – Heights and Distances
– Odd man out and Series

UNIT V   DATA INTERPRETATION   6
Tabulation – Bar graphs – Pie graphs – Line graphs

Total No. of Periods : 30

REFERENCE BOOKS:
1. R.S.Agarwal- A modern approach to Logical Reasoning-S.Chand and Co.- (2017).
2. R.S.Agarwal- A modern approach to Verbal and Non verbal Reasoning-S.Chand and Co.- (2017).
3. R.S.Agarwal- Quantitative Aptitude for Competitive Examinations-S.Chand and Co.- (2017).
4. A.K.Gupta- Logical and Analytical Reasoning- Ramesh Publishing House- (2014).
5. B.S.Sijwali-Indusijwali- A new approach to Reasoning (Verbal and Non verbal)-Arihant
   Publishers- (2014).

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Subject Code: BBE19L11	Subject Name: MINI PROJECT/IN PLANT TRAINING/INDUSTRIAL TRAINING	T /L/ ETL	L	T / S.Lr	P / R	C
	Prerequisite: --	L	0	0/0	3/0	1

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- The main objective of the Inplant training is to provide a short-term work experience in an Industry/ Company/ Organization

COURSE OUTCOMES (Cos): (3-5)

CO1	To get an insight of an industry / organization/company pertaining to the domain of study.
CO2	To acquire skills and knowledge for a smooth transition into the career.
CO3	To gain field experience and get linked with the professional network.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	L	L	L	H	H	H	H	H	H	H
CO2	H	M	H	H	M	H	H	H	H	H	H	M
CO3	H	H	H	H	M	H	H	H	H	H	H	M

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	H	H	H	H	H		
CO2	H	H	H	H	H		
CO3	H	H	H	H	H		

H/M/L indicates Strength of Correlation   H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							√					

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Subject Code:	Subject Name : TECHNICAL SKILL III		T / L/ ETL	L	T / S.Lr	P/ R	C
BBE19TS3	Prerequisite: TECHNICAL SKILL II		L	0	0/0	3/0	1

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : The objective is to develop the technical skill of the students.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Develop the technical skills required in the field of study
CO2	Bridge the gap between the skill requirements of the employer or industry and the competency of the students.
CO3	Enhance the employability of the students.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	M	M	H	M	H	M
CO2	H	H	M	H	H	H	M	M	H	H	H	H
CO3	H	H	H	H	H	H	M	M	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3					
CO1	H	H	H					
CO2	H	H	H					
CO3	H	H	H					

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
								✓				

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Subject Code: BBE19012	Subject Name :ETHICS FOR BIOMEDICAL ENGINEERS		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:		T	3	1/0	0/0	4

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To acquire knowledge about Introduction to ethics/bioethics
- To learn Ethical implications of cloning
- To learn about Human genome project and its ethical issues
- To learn about Introduction to Medical ethics.
- To learn the Ethical theories & moral principles

COURSE OUTCOMES (COs) : (3- 5)

CO1	Students will be able to use biological databases and use DBMS systems to inanipubte data
CO2	To use biological databases and use DBMS systems to inanipubte data
CO3	To analyze sequence similarity
CO4	Gain knowledge to analyses evolution of genes and proteins using phylogeny and model protein structures
CO5	Apply the R language in bioinformatics applications

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	H	M	M	H	M	H	M	H
CO2	H	M	H	M	H	H	H	M	H	M	H	M
CO3	M	H	H	H	H	M	M	H	M	H	M	H
CO4	L	M	M	L	M	H	M	H	H	L	H	L
CO5	M	H	H	H	H	M	H	H	M	H	M	M

COs / PSOs	PSO1	PSO2	PSO3		
CO1	M	M	H		
CO2	L	M	L		
CO3	H	M	H		
CO4	M	H	M		
CO5	M	H	H		

H/M/L indicates Strength of Correlation   H- High- M- Medium- L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

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BBE19012   ETHICS FOR BIOMEDICAL ENGINEERS   3   1/0   0/0   4

UNIT I   INTRODUCTION TO ETHICS/BIOETHICS   12
framework for ethical decision making; biotechnology and ethics – benefits and risks of genetic engineering – ethical aspects of genetic testing – ethical aspects relating to use of genetic information – genetic engineering and biowarfare

UNIT II ETHICAL IMPLICATIONS OF CLONING   12
Reproductive cloning - therapeutic cloning ; Ethical- legal and socio-economic aspects of gene therapy- germ line- somatic- embryonic and adult stem cell research- GM crops and GMO's – biotechnology and biopiracy – ELSI of human genome project

UNIT III   HUMAN GENOME PROJECT AND ITS ETHICAL ISSUES   12
Gene testing- prenatal diagnosis- genetic manipulations- germ line therapy- genitive studies on ethnic races.

UNIT IV   INTRODUCTION TO MEDICAL ETHICS   12
Definition- Scope of ethics in medicine- American medical Association code of ethics- CMA code of ethics- Fundamental Responsibilities -The Doctor And The Patient- The Doctor And The Profession- Professional Independence- The Doctor And Society.

UNIT V   ETHICAL THEORIES & MORAL PRINCIPLES   12
Deontology & Utilitarianism-Casuist theory- Virtue theory- The Right Theory. Principles-Non-Maleficence- Beneficence- Autonomy- Veracity-Justice. Autonomy & Confidentiality issues in medical practice- Ethical Issues in biomedical research.

Total No of Periods: 60

TEXT BOOKS:
1. Domiel A Vallero, "Biomedical Ethics for Engineers", Elsevier Pub.1st edition, 2007
2. Johnna Fisher,"Biomedical Ethics: A Canadian Focus", Oxford University Press Canada, 2009

REFERENCE BOOKS:
1. Robert   M Veatch, "Basics of Bio Ethics", Second Edition. Prentice Hall-Inc, 2003.
2. Jose Cibelli, Robert P. lanza- Keith H. S. Campbell- MichaelD. West , "Principles of cloning",Academic Press, 2002.

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Subject Code: BIT17I01	Subject Name : BIO INFORMATICS		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:		T	3	0/0	0/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:
- To learn nucleotide- protein and genome databases and know about the file formats.
- To understandpairwise and multiple sequence alignment and the principle and to gain knowledge on approaches for gene prediction.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Develop bioinformatics tools with programming skills.
CO2	Apply computational based solutions for biological perspectives.
CO3	Pursue higher education in this field.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	H	M	M	H	M	H	M	H
CO2	H	M	H	M	H	H	H	M	H	M	H	M
CO3	M	H	H	H	H	M	M	H	M	H	M	H

COs / PSOs	PSO1	PSO2	PSO3									
CO1	M	M	H									
CO2	L	M	L									
CO3	H	M	H									

H/M/L indicates Strength of Correlation   H- High- M- Medium- L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

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BIT17I01	BIO INFORMATICS	3	0/0	0/0	3

UNIT I   BIOLOGICAL DATABASES AND DATA RETRIEVAL   9

Nucleotide databases (Genbank- EMBL- DDBJ)- Sequence submission Methods and tools (Sequin-Sakura-Bankit)-Sequence retrieval systems (Entrez & SRS)- Sequence File Formats and Conversion tools- Protein (Swiss-Prot- Tr-EMBL- PIR_PSD-Expasy)- Genome (NCBI- EBI- TIGR- SANGER)- Derived Databases (Prosite- PRODOM-Pfam-PRINTS)- Metabolic Pathway DB (KEGG- EMP)-

UNIT II   PAIRWISE SEQUENCE ALIGNMENT   9

Similarity- Identity and Homology- Global Alignment- Local Alignment- Visual Alignment- Dynamic Programming- Heuristic approach- Database Search methods & tool- PAM & BLOSUM Matrices and Gap penalty-Assessing the Significance of Sequence Alignments

UNIT III   MULTIPLE SEQUENCE ALIGNMENT   9

Significance of MSA- Various approaches for MSA (Progressive & Iterative)- Profile analysis- Block analysis-Pattern searching- Motif analysis. Statistical methods for aiding alignment –- Gibbs Sampling-Hidden MarkovModels- Algorithm of HMM-based approaches- Bali Base-Scoring of MSA- PSI/PHI-BLAST

UNIT IV   GENE PREDICTION   9

Aryotes- Gene prediction methods- Neural Networks- Pattern Discrimination methods- Signal sites Predictions(Promoter- Splice- UTR- CpG-islands)- Evaluation of Gene Prediction Methods-Prediction methods using DNAsequences **-** Michael Zhan's Exon Finder- Gene scan

UNIT V   PHYLOGENETIC ANALYSIS & SOFTWARES IN BIOINFORMATICS   9

Methods of Construction of Phylogenetic trees- Maximum Parsimony Method- Maximum likelihood method andDistance Methods Emboss - Cn3D viewer- Rasmol-Swiss pdb viewer-Pymol-Jmol. Modeling-Docking -Auto dock

Total No of Periods: 45

TEXT BOOKS:

1. I A. Lesk,"Introduction to Bioinformatics", 3rdEdition, Oxford University Press, 2002
2. Jeremy Ramsden,"Bioinformatics: An Introduction".
3. **3.** Shui Qing Ye,"Bioinformatics: A Practical Approach".

REFERENCE BOOKS:

1. **1.** Pierre llaldi and SorciiBrunak,"Bioinformatics: The Machine Learning Approach".

Subject Code: BBE19ET4	Subject Name : INTELLECTUAL PROPERTY RIGHTS AND BIOSAFETY		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:		ETL	1	0/1	3/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To make the student understand Introduction to Intellectual Property
- To impart knowledge on Basics of Patents and Concept of Prior Art.
- To impart knowledge on Patent filing procedures
- To educate on Biosafety
- To introduce the Biosafety guidelines.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Ability to analyze functioningof fermentation process
CO2	Ability to study for fermentation process
CO3	Ability to study sterilization kinetics.
CO4	Gain knowledge aboutthe phenomenon ofmetabolic stoichiometry and energetics
CO5	Understands the concept of phenomenon of rectifiers

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	L	H	M	H	M	L	M	H
CO2	M	H	M	M	H	M	H	M	H	M	H	H
CO3	H	H	H	H	M	M	H	M	H	L	M	H
CO4	M	H	L	M	H	M	H	M	H	M	L	M
CO5	H	M	H	M	H	M	L	M	H	L	M	M

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	M
CO2	M	H	M
CO3	H	M	H
CO4	M	M	H
CO5	M	M	L

H/M/L indicates Strength of Correlation   H- High- M- Medium- L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

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**BBE19ET4   INTELLECTUAL PROPERTY RIGHTS AND   1   0/1   3/0   3
                    BIOSAFETY**

UNIT I INTRODUCTION TO INTELLECTUAL PROPERTY   9
Types of IP: Patents- Trademarks- Copyright & Related Rights- Industrial Design- Traditional Knowledge- Geographical Indications- Protection of GMOs- IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies; History of GATT & TRIPS Agreement; Madrid Agreement; Hague- Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent- Act 1970 & recent amendments.

UNIT II   BASICS OF PATENTS AND CONCEPT OF PRIOR ART   9
Introduction to Patents; Types of patent applications: Ordinary-PCT- Conventional- Divisional and Patent of Addition;Specifications: Provisional and complete; Forms and fees Invention in context of "prior art"; Patent databases; Searching- International Databases; Country-wise patent searches (USPTO-esp@cenet(EPO)-PATENT Scope(WIPO)- IPO- etc.)

UNIT III   PATENT FILING PROCEDURES   9
National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; precautions while patenting –disclosure/non-disclosure; Financial assistance for patenting -introduction to existing schemes- Patent licensing and agreement- Patent infringement- meaning- scope- litigation- case studies.

UNIT IV   BIOSAFETY   9
Introduction; Historical Background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals;

UNIT IV   BIOSAFETY GUIDELINES   9
 Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee- RCGM- GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; overview of National Regulations and relevant International Agreements including Cartegana Protocol.

                                                                    Total No of Periods: 45

TEXT BOOKS:

1. BAREACT Indian Patent Act 1970 Acts & Rules- Universal Law Publishing Co. Pvt. Ltd.- 2007
2. Kankanala C, Genetic Patent Law & Strategy- 1st Edition-Manupatra Information Solution Pvt. Ltd.- 2007

REFERENCE BOOKS:
1. http://www.w3.org/IPR/
2. http://www.wipo.int/portal/index.html.en
3. http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html

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Subject Code: BBE19L12	Subject Name : GENETIC ENGINEERING LAB		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:		L	0	0/0	3/0	1

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To understand the basics of genetics
- To understand the working of chromosomes
- To understand the concepts of alleles
- To give an insight to crossing over & gene transfer
- To study about the genetics and biotechnology

COURSE OUTCOMES (COs) : (3- 5)

CO1	understands the basics of genetics
CO2	understands the workingof chromosomes
CO3	understands the concepts of alleles
CO4	Acquires knowledge on the crossing over & gene transfer
CO5	Acquires knowledge on the genetics and biotechnology

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	H	M	H	M	M	H	M	H	M	H
CO2	H	M	M	M	M	H	H	M	H	M	H	M
CO3	M	H	H	H	H	M	M	H	M	H	M	H
CO4	M	M	M	M	M	H	M	M	H	M	H	M
CO5	M	H	H	H	H	M	H	H	M	H	M	M

COs / PSOs	PSO1	PSO2	PSO3
CO1	M	M	H
CO2	H	H	M
CO3	M	M	H
CO4	M	M	M
CO5	H	H	M

H/M/L indicates Strength of Correlation   H- High- M- Medium- L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					

BBE19L12   **GENETIC ENGINEERING LAB**   **0**   **0/0**   **3/0**   **1**

LIST OF EXPRIMENTS

1. Plasmid Isolation.
2. Restriction Digestion of DNA.
3. Ligation.
4. Gel Elution of DNA.
5. Preparation of Competent Cells.
6. Transformation.
7. Polymerase Reaction.

Total No of Periods: 45

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Subject Code: BBT17L09	Subject Name : BIOINFORMATICS LAB		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:		L	0	0/0	3/0	1

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To enable the students to understand
- To understand basic commands in UNIX OS.
- To understand different biological databases.
- To carry out sequence and phylogenetic analysis.

COURSE OUTCOMES (COs) : (3- 5)

CO1	To demonstrate the protein/DNA sequence search methods and sequence alignment databases. To understand and hands-on-training on the genome sequence analysis and annotation.
CO2	To analyze the comparative genomics.
CO3	To use various computational tools for expression analysis to identify open reading frames- mutations- conserved region

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	H	M	H	M	M	H	M	H	M	H
CO2	H	M	M	M	M	H	H	M	H	M	H	M
CO3	M	H	H	H	H	M	M	H	M	H	M	H

COs / PSOs	PSO1		PSO2		PSO3	
CO1	M		M		H	
CO2	H		H		M	
CO3	M		M		H	

H/M/L indicates Strength of Correlation   H- High- M- Medium- L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					

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BBT17L09	**BIOINFORMATICS LAB**	0	0/0	3/0	1

LIST OF EXPERIMENTS

1. Demonstration of Entrez and SRS
2. Exploring nucleotide database GenBank
3. Exploring Protein Database Uniprot
4. Database Searches with BLASTP and PSI BLAST
5. Protein secondary structure prediction
6. Pairwise Sequence Alignment -EMBOSS
7. Multiple sequence alignment – CLUSTAL OMEGA
8. Primer BLAST
9. Phylogenetic analysis
10. Simple Sequence Formats- Sequin(demo)

Total No of Periods: 45

REFERENCE BOOK
1. Jonathan Pevsner,"Bioinformatics and Functional Genomics".
2. Vince Buffalo,"Bioinformatics Data Skills: Reproducible and Robust Research with Open".
3. Jean-Louis Ryan Rossi- Stephen Sheel, "Introduction to Bioinformatics Using Action Labs".

Subject Code: BBE19L13	Subject Name : PROJECT PHASE - 1		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None		L	0	0/0	3/3	2

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The objective of the Main Project is to culminate the academic study and provide an opportunity to explore a problem or issue-address through focused and applied research under the direction of a faculty mentor. The project demonstrates the student's ability to synthesize and apply the knowledge and skills acquired to real-world issues and problems. This project affirms the students to think critically and creatively-find an optimal solution-make ethical decisions and to present effectively.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Apply the knowledge and skills acquired in the course of study addressing a specific problem or issue.
CO2	To encourage students to think critically and creatively about societal issues and develop user friendly and reachable solutions
CO3	To refine research skills and demonstrate their proficiency in communication skills.
CO4	To take on the challenges of teamwork-prepare a presentation and demonstrate the innate talents.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	M	H	H	L	M	M	H	H
CO2	H	H	H	H	H	H	H	M	M	M	H	H
CO3	H	H	H	H	H	H	H	M	M	H	H	M
CO4	H	M	H	H	H	H	M	H	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3						
CO1	H	H	H						
CO2	H	H	H						
CO3	H	H	H						
CO4	H	H	H						

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					

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Subject Code: BHS18FLX	Subject Name : FOREIGN LANGUAGE	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	L	0	0/0	3/0	1

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To recognize the cultural values-practices-and heritage of the foreign country-communicate effectively in a foreign language and interact in a culturally appropriate manner with native speakers of that language.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Achieve functional proficiency in listening-speaking-reading-and writing.
CO2	Develop an insight into the nature of language itself-the process of language and culture acquisition.
CO3	Decode-analyze-and interpret authentic texts of different genres.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L	L	L	H	L	H	M	H	H	L
CO2	M	L	L	L	L	H	L	H	H	H	H	L
CO3	L	L	M	M	L	H	M	H	M	H	H	L

COs / PSOs	PSO1	PSO2	PSO3									
CO1	L	L	L									
CO2	L	L	L									
CO3	L	L	L									

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
			✔									

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Subject Code: BBE19013	Subject Name :IOT FOR BIOMEDICAL SECTOR	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	T	3	1/0	0/0	4

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To introduce IoT in bio-medical engineering
- To impart knowledge about IoT in Image-guided surgery (IGS)-
- To educate on IoT in health care
- To educate onIoT application I.
- To educate on IoT application II

COURSE OUTCOMES (COs) : (3- 5)

CO1	Ability to know IoT in bio-medical engineering
CO2	Ability to take care of IoT in Image-guided surgery(IGS)
CO3	Gain knowledge on IoT in health care
CO4	Gain knowledge on IoT application I.
CO5	Gain knowledgeon IoT application II

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	L	M	L	H	M	H	M	L	M	H
CO2	M	H	M	L	H	H	H	M	H	M	H	H
CO3	L	H	H	H	M	L	H	H	H	L	M	H
CO4	M	H	L	M	H	M	L	M	H	M	L	L
CO5	L	M	M	L	H	M	L	M	M	L	M	L

COs / PSOs	PSO1	PSO2	PSO3									
CO1	H	H	M									
CO2	M	H	L									
CO3	H	L	H									
CO4	L	M	H									
CO5	M	H	h									

H/M/L indicates Strength of Correlation   H- High- M- Medium- L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

| BBE19013 | IOT FOR BIOMEDICAL SECTOR | 3 | 1/0 | 0/0 | 4 |

UNIT I   IOT IN BIO-MEDICAL ENGINEERING   12

emerging of IoT in e-health care-IoMT system architecture-Smart health care and wearables-for doctors and patients –Reducing waiting time in case of emergency-Enhanced medicine management-smart beds for patients.

UNIT II   IOT IN IMAGE-GUIDED SURGERY(IGS)   12

performance evaluation of IGS – System functionality and components- IGS tracking tools- imaging modalities –Merits and demerits of IGS-Applications of IGS.

UNIT III   INTERNET OF THINGS IN HEALTH CARE   12

architecture of healthcare IoT -biomedical signal compression-Neuroergonomics-cloud computing-Innovative IoT applications in healthcare-Biosensors-Machine learning applications-Block chain-based initiatives.

UNIT IV   IOT APPLICATIONS I   12

Role of IoT in agriculture-smart farm irrigation system-Technology advancements in smart farming - Effective usage of IoT in farming.

UNIT V   IOT APPLICATIONS II   12

Introduction to IoT in Life sciences – Sensors used in IoT- Organ-on-a-chip- Chip in a pill-sensors in drug delivery devices- Digital and 3D printed pills- Automatic smart wheelchairs-wearables and wristbands. benefits of IoT in life sciences. Challenges of IoT in life sciences.

Total No of Periods: 60

TEXT BOOKS:

1. Valentina E, Balas Le Hoang Son and Sudan Jha,"Internet of Things in Biomedical Engineering", Elsevier, Academic press, 2019.

REFERENCE BOOKS:

1. Catarina Reis and Marisa da Silva Maximiano,"Internet of Things and Advanced Application in Health care", IGI Global Publiishers, USA, 2017.

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Subject Code: BBE19014	Subject Name : OCCUPATIONAL BIOMECHANICS AND NEUROMECHANICS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To introduce Occupational Biomechanics
- To impart knowledge on Bioinstrumentation for Occupational Biomechanics.
- To educate on Biomechanical Considerations.
- To introduce the phenomenon of Neuromechanics fundamentals.
- To introduce Feasible Actions

COURSE OUTCOMES (COs) : (3- 5)

CO1	Ability to introduce Occupational Biomechanics
CO2	Ability to take care of Bioinstrumentation for Occupational Biomechanics
CO3	Ability tohandle BiomechanicalConsiderations.
CO4	Gain knowledge about the phenomenon ofNeuromechanics fundamentals
CO5	Understands the concept of Feasible Actions

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	L	H	M	H	M	L	M	H
CO2	M	H	M	L	H	M	H	M	H	M	H	H
CO3	L	H	H	H	M	L	H	M	H	H	L	M
CO4	M	H	L	M	H	M	L	M	H	M	L	L
CO5	L	M	H	M	H	M	L	M	H	L	M	L

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	M
CO2	M	H	M
CO3	H	L	H
CO4	M	M	H
CO5	H	M	L

H/M/L indicates Strength of Correlation   H- High- M- Medium- L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

B.Tech. –Biomedical Engineering (2018 Regulations)

BBE19014	OCCUPATIONAL BIOMECHANICS AND NEUROMECHANICS	3	0/0	0/0	3

UNIT I   OCCUPATIONAL BIOMECHANICS   9

Definition-need for an Occupational biomechanics specialty -Anthropometry in occupational Biomechanics- Mechanical Work-Capacity Evaluation-joint motion and Muscle strength evaluation.

UNIT II   BIOINSTRUMENTATION FOR OCCUPATIONAL BIOMECHANICS   9

Bioinstrumentation for Occupational Biomechanics- Occupational Biomechanical Models-Methods of classifying and evaluating manual work- Manual material-Handling Limits-Sitting.

UNIT III   BIOMECHANICAL CONSIDERATIONS   9

Biomechanical Considerations in Machine Control and Workplace Design-Hand-Tool Design Guidelines-Guidelines for whole-Body and Segmental Vibration-Worker selection- Training and Personal Protective Device Considerations.

UNIT IV   NEUROMECHANICS FUNDAMENTALS   9

Limb kinematics-Limb Mechanics- Tendon Driven Limbs-Introduction to the neural control of Tendon-Driven Limbs-The neural control of Musculotendon lengths and Excursions is overdetermined

UNIT V   FEASIBLE ACTIONS   9

Feasible Actions of Tendon-Driven Limbs- Feasible neural commands and feasible mechanical outputs-Neuromechanics as a scientific tool- the nature and structure of Feasible sets-Implications

Total No of Periods: 45

TEXT BOOKS:

1. Don B. Chaffin, Gunnar B.J. Andersson, Bernard J, "Occupational BioMechanics", Published by John wiley& Sons- Inc.1999.

REFERENCE BOOKS:

1. Francisco J. Valero Cuevas, "Fundamentals of Neuromechanics", Springer, London, 2016.

Subject Code:BBE19L14	Subject Name : **PROJECT PHASE - 2**		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None		L	0/0	0/0	12/12	8

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The objective of the Main Project is to culminate the academic study and provide an opportunity to explore a problem or issue-address through focused and applied research under the direction of a faculty mentor. The project demonstrates the student's ability to synthesize and apply the knowledge and skills acquired to real-world issues and problems. This project affirms the students to think critically and creatively-find an optimal solution-make ethical decisions and to present effectively.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Apply the knowledge and skills acquired in the course of study addressing a specific problem or issue.
CO2	To encourage students to think critically and creatively about societal issues and develop user friendly and reachable solutions
CO3	To refine research skills and demonstrate their proficiency in communication skills.
CO4	To take on the challenges of teamwork-prepare a presentation and demonstrate the innate talents.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	H	H	H	H	H
CO2	H	H	H	H	H	H	H	H	H	H	H	H
CO3	H	H	H	H	H	H	H	H	H	H	H	H
CO4	H	H	H	H	H	H	H	H	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3			
CO1	H	H	H			
CO2	H	H	H			
CO3	H	H	H			
CO4	H	H	H			

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Eletives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					

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Subject Code: BBE19E01	Subject Name : MECHANICS OF HUMAN MOVEMENT	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: BASICS IN Physics and digital electronics	T	3	0/0	0/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To introduce Biomechanics
- To impart knowledge on **fundamentals** of biomechanics
- To educate onmuscular mechanics
- To introduce the phenomenon ofbiomechanics art
- To introduce biomechanics techniques

COURSE OUTCOMES (COs) : (3- 5)

CO1	Ability to introduce Biomechanics
CO2	Ability to take care of fundamentals of biomechanics
CO3	Ability to handle muscular mechanics.
CO4	Gain knowledge about the phenomenon of biomechanics art
CO5	Understands the concept of biomechanics techniques

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	L	H	M	H	M	L	M	H
CO2	H	H	M	H	H	M	H	M	H	M	H	H
CO3	L	H	H	H	M	L	H	M	H	L	H	M
CO4	M	H	L	H	H	L	M	M	L	M	L	L
CO5	M	M	H	M	H	M	H	H	H	L	M	L

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	M
CO2	M	L	M
CO3	H	M	L
CO4	M	L	M
CO5	M	M	M

H/M/L indicates Strength of Correlation   H- High- M- Medium- L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

BBE19E01   MECHANICS OF HUMAN MOVEMENT   3   0/0   0/0   3

UNIT I   BIOMECHANICS   9
Importance of Biomechanics-Biomechanics division- Anatomy of Human motion-Bones-Joints- Muscles-Functional anatomy and biomechanics.

UNIT II   FUNDAMENTALS OF BIOMECHANICS   9
Kinematics in linear motion-kinematics in Angular motion-kinetics in linear motion-kinetics in angular motion.

UNIT III   MUSCULAR MECHANICS   9
The concept of Muscular mechanics –Lever systems-kinematic chain-static -dynamic activity and newton's law. Movement control(Muscular physiology)- muscular and neurological control.

UNIT I   BIOMECHANICS ART   9
Martial arts Biomechanics- The bio mechanics of Throwing Arts-JUDO-JUJUTSU and SAMBO-Amateur Wrestling-Biomechanical analysis of the techniques-Grounding techniques-JUDO-JUJUTSU and SAMBO-WRESTLING

UNIT V   BIOMECHANICS TECHNIQUES   9
The Biomechanics of Striking-kicking Arts- Karate-Boxing-Biomechanical analysis of the techniques. The Defense and Attack on Vital points-The biomechanics of the sword art and its analysis-Biomechanics of the Knife Defense.

Total No of Periods: 45

TEXT BOOKS:

1. Taylor &francis Group LLC,"Biomechanics of Human Motion-application in the Martial Arts"EmericArus, CRC Press,2013.
2. Kinesiology,"The Mechanics and Pathomechanics of Human Movement", Carol A. Oatis, Wolters Kluwer Publications, 2017.

REFERENCE BOOKS:

1. James Watkins, "Introduction to Mechanics of Human Movement",Mandinam Press, 2012.

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Subject Code: BBE19E02	Subject Name : LIFE SCIENCES		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None		T	3	0/0	0/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To introduce Evolution of life science
- To impart knowledge on Ecology
- To educate onbioenergetics and metabolism.
- To introduce the Prokaryotes and Viruses.
- To introduce concept ofimmunology

COURSE OUTCOMES (COs) : (3- 5)

CO1	Ability to Evolution of life science
CO2	Acquire knowledge on Ecology
CO3	Ability to understand bioenergetics and metabolism.
CO4	Gain knowledge about the Prokaryotes and Viruses
CO5	Understands the concept of immunology

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	L	H	M	H	M	L	M	H
CO2	M	H	M	L	H	M	H	M	H	M	H	H
CO3	L	H	H	H	M	L	H	M	H	L	M	H
CO4	M	H	L	M	H	M	L	M	H	M	L	L
CO5	L	M	H	M	H	M	L	M	H	L	M	L

COs / PSOs	PSO1	PSO2	PSO3			
CO1	H	H	M			
CO2	M	H	M			
CO3	H	M	H			
CO4	M	M	H			
CO5	M	M	M			

H/M/L indicates Strength of Correlation   H- High- M- Medium- L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

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BBE19E02	**LIFE SCIENCES**	3	0/0	0/0	3

UNIT I   EVOLUTION   9

Origin of life -Theories of evolution –Pattern of evolution- Population genetics-species and speciation-Evolutionary forces involved in speciation-pattern of evolutionary changes-nature of evolution-molecular phylogeny.

UNIT I I   ECOLOGY   9

Adaptation and Acclimatization - Shelford's law of tolerance-Ecological species concept - Habitat and niche - The ecosystem concept-Biomes - Population ecology-Biotic community-Biodiversity - Environmental pollution - Bioremediation.

UNIT I II   BIOENERGETICS AND METABOLISM   9

Respiration-Glyoxylate   cycle-Photosynthesis-Photorespiration-Carbohydrate   metabolism-lipid metabolism-Amino acid metabolism- Nucleotide metabolism.

UNIT I V   PROKARYOTES AND VIRUSES   9

General features and phylogenetic overview-Structure of bacterial cell-Bacterial genome and Bacterial nutrition-Bacterial taxonomy-General features of important bacterial groups-Archaebacteria-Bacterial toxins-control of microbial growth-Virus-Prions and Viroid.

UNIT V   IMMUNOLGY   9

Innate immunity-Adaptive immunity-Cells of the immune system-organs involved in the adaptive immune response-Antigens-Immunoglobulins:structure and function-T-cells and CMI- Cytokines-Hyper sensitivity-Autoimmunity.

Total No of Periods: 45

TEXT BOOKS:

1. Pranav kumar, Usha Mina,"Life Sciences Fundamentals and Practice – I",-Pathfinder Publication, New Delhi, India, 2015.
2. Pranav kumar, Usha Mina, "Life Sciences Fundamentals and Practice – II", Pathfinder Publication, New Delhi, India, 2015.

REFERENCE BOOKS:

1. Barbara A. Osborne and Janis Kuby,"Immunology", Publisher W.H.Freeman, 2017.

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Subject Code: BBI18E03	Subject Name : BIOMATERIALS AND IMPLANTABLE DEVICE		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: BIOMEDICAL INSTRUMENTATION		T	3	0/0	0/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- Learn characteristics and classification of Biomaterials
- Understand different metals and ceramics used as biomaterials
- Learn polymeric materials and combinations that could be used as a tissue replacement implants
- Know the various artificial organs developed using these materials to perform medical application.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Analyze different types of Biomaterials and its classification.
CO2	Perform combinations of materials that could be used as a tissue replacement implant.
CO3	Know about the various polymeric materials used for medical applications
CO4	About bio-ceramics and its applications in medicine
CO5	The graduate will be capable to perform medical application.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	M	H	M	L	H	M	H	L	L	M
CO2	M	M	H	M	L	H	M	L	H	M	L	H
CO3	H	H	H	M	H	M	H	L	H	M	H	M
CO4	H	H	M	L	H	M	L	H	M	L	H	M
CO5	M	H	M	L	H	M	L	H	M	L	H	M

COs / PSOs	PSO1	PSO2	PSO3
CO1	M	H	M
CO2	H	M	H
CO3	M	M	L
CO4	H	L	M
CO5	L	M	M

H/M/L indicates Strength of Correlation   H- High- M- Medium- L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

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| BBI18E03 | **BIOMATERIALS AND IMPLANTABLE DEVICES** | 3 | 0/0 | 0/0 | 3 |

UNIT I   BIOCOMPATIBILITY AND HEMOCOMPATIBILITY   9

Overview of Biomaterials used as medical devices- Classification of biomaterials- Impact and future of biomaterials- performance of implants- Interfacial phenomena and tissue response to biomaterials- Metals and alloys for orthopaedic implants- Stainless steel- Cobalt chromium alloy- Titanium and its alloys. Electro kinetic factors. Types of orthopedic fixation devices- pins- screws and plates- IM nails and spinal.

UNIT II   BIOELECTRIC EFFECT   9

Wolff'slaw. Interface problems with artificial joints and various fixation methods. Failure of implantation materials- metallic corrosion- wear- metallic implant fractures and their impact on biological systems. Hard tissue replacements- total hip and knee joint replacements

UNIT III   POLYMERS IN BIOMEDICAL USE   9

Hydrogels- silicone rubber- biodegradable polymers- microorganisms in polymeric implants and polymer sterilization - Biopolymers- Synthetic polymers- Composites- Types and Applications- Contraceptive devices.

UNIT IV   ORTHOPAEDIC IMPLANTS   9

Ophthalmology – introduction- contact lenses- eye shields and artificial tears- Biological Tests-Material surface characterization. Corrosion- Standards on biomaterials.

UNIT V   BIOCERAMICS- TYPES   9

Bioactive- resorbable- non-resorbable. Stoichiometry and Ca/P ratio of various forms calcium phosphates-bio ceramic coatings on metallic implants and bone bonding reactions on implantation. Hydroxyapatite –properties and applications. Bone cements and bio glasses- Dental implants- materials-types and designs.

Total No of Periods: 45

TEXT BOOKS:

1. Sujata V Bhat, "Biomaterials",Narosa Publishing House, New Delhi, 2002.
2. A.F. Von Recum, "Handbook of Biomaterials Evaluation – Scientific".
3. Taylor & Francis , "Technical and Clinical Testing of Implant Materials", 2ndEdition, Philadelphia, 1999.
4. F. Silver and C. Dillon, "Biocompatibility: Interactions of Biological and Implantable Materials" Vol.1- VCH Publishers, New York- 1989.
5. Park. J.B. "Biomaterials: An Introduction", CBS Publishers, 2007.

REFERENCE BOOKS:

1. L.L. Hench and E.C. Ethridge, "Biomaterials: An Interfacial Approach", Academic press, New York, 1982.
2. F.H. Silver, "Biomaterials- Medical Devices and Tissue Engineering: An Integrated Approach" 1st Edition, Chapman & Hall- London, 1994.
3. Buddy Ratner etal., "Biomaterials Science: An Introduction to Materials in Medicine", Academic Press, San Diego- 2004.

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Subject Code: BBE19E03	Subject Name : COMPUTERS IN MEDICINE		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:		T	3	0/0	0/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- ➤ To learn about Overview of Computer Hardware
- ➤ To gain knowledge on System Design
- ➤ To study about Computers in Patient Monitoring
- ➤ To learn Computers in Medical Systems Modeling
- ➤ To gain knowledge on Computers in Medical Research

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understands the Overview of Computer Hardware
CO2	Gains knowledge on System Design
CO3	Acquires knowledge on Computers in Patient Monitoring
CO4	Understands Computers in Medical Systems Modeling
CO5	Acquires knowledge on Computers in Medical Research

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	L	M	H	L	M	H	M	L	M	H
CO2	H	M	L	M	H	L	M	L	H	M	L	M
CO3	L	M	H	L	M	H	L	M	H	L	M	H
CO4	H	M	L	M	H	L	M	H	L	M	H	L
CO5	M	H	L	M	H	L	M	H	L	M	H	L

COs / PSOs	PSO1	PSO2	PSO3									
CO1	M	L	H									
CO2	H	M	H									
CO3	M	L	H									
CO4	H	L	M									
CO5	L	M	H									

H/M/L indicates Strength of Correlation   H- High- M- Medium- L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

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BBE19E03   **COMPUTERS IN MEDICINE**   **3   0/0   0/0   3**

UNIT I   OVERVIEW OF COMPUTER HARDWARE PC-AT   9

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

UNIT II   SYSTEM DESIGN   9

Multichannel computerized ECG- EMG and EEG data acquisition- storage and retrieval- transmission of signal and images.

UNIT III   COMPUTERS IN PATIENT MONITORING   9

Physiological monitoring- automated ICU-computerized arrhythmia monitoring-information flow in a clinical lab-computerized concepts- interfacing to HIS

UNIT IV   COMPUTERS IN MEDICAL SYSTEMS MODELING   9

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

UNIT V   COMPUTERS IN MEDICAL RESEARCH   9

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

Total No of Periods: 45

TEXT BOOKS:

1. R.D.Lele, "Computers in Medicine", Tata McGrawHill, New Delhi, 1999.

REFERENCE BOOKS:

1. Douglas V.Hall, "Microprocessors and Interfacing : Programming and hardware", McGraw Hill, Singapore, 1999.

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Subject Code: BBI18E04	Subject Name : LASER AND ULTRASONIC APPLICATION IN MEDICINE	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	T	3	0/0	0/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To Gain Knowledge of Laser
- To Study About Ultrasonic
- To Learn About Ultrasonic Scanners
- To Study About High Energy Ultrasonic
- To Gain Knowledge of Holographic Application in Medicine

COURSE OUTCOMES (COs) : (3- 5)

CO1	Acquires Knowledge of Laser
CO2	Graduate acquires knowledge on Ultrasonic
CO3	Capable to analyze Ultrasonic Scanners
CO4	Understands High Energy Ultrasonic
CO5	Acquires knowledge on Holographic Application in Medicine

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	M	L	M	H	M	L	H	M	L	M
CO2	H	M	L	M	H	L	M	L	H	M	L	M
CO3	L	M	H	L	M	H	L	M	H	L	M	H
CO4	H	M	L	M	H	L	M	H	L	M	H	H
CO5	M	L	H	H	M	L	H	M	L	M	H	M

COs / PSOs	PSO1	PSO2	PSO3
CO1	M	H	L
CO2	M	L	H
CO3	H	M	L
CO4	M	H	L
CO5	L	M	H

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

B.Tech. −Biomedical Engineering (2018 Regulations)

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| BBI18E04 | LASER AND ULTRASONIC APPLICATION IN MEDICINE | 3 | 0/0 | 0/0 | 3 |

UNIT I   LASER   9

Principles of Laser action-different types and of lasers and its operation-Applications of Laser in Biology-Dentistry-Ophthalmology-Dermatology-Medicine-Surgery-Interferometer   Applications-Flurorescence studies in cancer Diagnosis-Laser in Genetic Engineering-Low power applications in Medicine.

UNIT II   ULTRASONICS   9

Different Modes of Display- A-B-C-scanning Techniques-Absorption in biological Tissues-Measurement of Ultrasonic Energy-Construction of Ultrasonic probe-Ultrasonic Imaging in Abdomen-Breast-Heart-Chest-Eye-Kidney-Skull-Pulsatile Motion-Pregnant and non-Pregnant uterus.

UNIT III   ULTRASONIC SCANNERS   9

Real Time Echo-2-D Scanners-Colour Doppler

UNIT IV   HIGH ENERGY ULTRASONICS   9

Effects due to High energy ultrasonic applications in Surgery-Cell destruction-Cleaners

UNIT V   HOLOGRAPHIC APPLICATION IN MEDCINE   9

Wave front Recording and Reconstruction-Recording Media-Image forming application-Motion Induced Contrast-correlation filtering-Holograms using Ultrasonic signals and Hologram using Lasers.

Total No of Periods: 45

TEXT BOOKS:
1. Leon GoldmanM.D. and R. Jamies Rockwell Jr.,"Lasers in medicine Gordon and breach", science publishers Inc., New York, 1971.
2. Brown Y.H.V. and Dickson J.F. (Eds)- Advances in Bio – Medical Engineering Volume II and V, Academic press- London- 1972
3. Georg W. Stroke, Kock W.E.,"Ultrasonic Imaging and Holography", plenum press, New York, 1974

REFERENCE BOOKS:
1. Mertellucci S. Sand Chester A.N,"Laser Photo biology and photo medicine", plenum press, New York, 1989.
2. Wolbarsht M.L,"Laser Application in Medicine and Biology", Plenum press, New York, 1989.

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Subject Code: BBE19E04	Subject Name : CELLS IN THEIR ENVIRONMENT	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	T	3	0/0	0/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To Gain Knowledge of cell
- To   Gain Knowledge About Cellular Studies
- To Learn About Cellular Transport
- To Study About Cell Culture
- To Gain Knowledge of Case Study of Multiple Approaches

COURSE OUTCOMES (COs) : (3- 5)

CO1	Acquires Knowledge of cell
CO2	Graduate acquires knowledge on Cellular Studies
CO3	Capable to analyze Cellular Transport
CO4	Understands Cell Culture
CO5	Acquires knowledge on Case Study of Multiple Approaches

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	M	L	M	H	M	L	H	M	L	M
CO2	H	M	L	M	H	L	M	L	H	M	L	M
CO3	L	M	H	L	M	H	L	M	H	L	M	H
CO4	H	M	L	M	H	L	M	H	L	M	H	H
CO5	M	L	H	H	M	L	H	M	L	M	H	M

COs / PSOs	PSO1	PSO2	PSO3
CO1	M	H	L
CO2	M	L	H
CO3	H	M	L
CO4	M	H	L
CO5	L	M	H

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

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BBE19E04	CELLS IN THEIR ENVIRONMENT	3	0/0	0/0	3

UNIT I   CELL   9

Cell membrane and organelles- Ion channels- Receptors and carriers- Intercellular communication- Membrane potential- ActionPotential- Generation and Conduction- Blood Cells- Origin of RBC- structure and function of hemoglobin- Plasma proteins- Bonemarrow- Hematocrit- ESR and its significance- Blood volume regulation- blood coagulation and factors- Bleeding and clotting time.

UNIT II   CELLULAR STUDIES   9

Cell growth and differentiation- Cell and tissue mechanism- cell adhesion- cell migration- cellaggregation and tissue equivalent.

UNIT III   CELLULAR TRANSPORT   9

Transport across cell membranes – importance- classification – Active and passive- passive transport – movement of water- small lipid across membrane. Active – Na+ K+ ATPase Pump- Lysosomal andVacuolar pumps. Cotransport – Symport- antiport – examples- Endocytosis and Exocytosis transportacross prokaryotic membrane- entry of viruses and toxinsCase Studies

UNIT IV   CELL CULTURE   9

Different cell types- progenitor cells and cell differentiations- different kind of matrix- cell-cell interaction. Aspect of cell culture: cell expansion- cell transfer- cell storage and cell characterization- Bioreactors.

UNIT V   CASE STUDY OF MULTIPLE APPROACHES   9

Case study on cell transplantation for liver- musculoskeletal.

Total No of Periods: 45

TEXT BOOKS:

1. P.K. Gupta, "Cell and Molecular Biology", Rastogi Publication, 2003
2. Bruce Albert et al.,"Molecular Biology of the Cell", Taylor and Francis, 2002
3. Baltimore Damell J.,Lodish H. BaltimorD,"Molecular Biology of the Cell", FreemanPublications, 2003

REFERENCE BOOKS:
1. T. Coopper, "The Cell", John Wiley and Sons, 2005
2. VermaandAggarval S,"Cytology", Chand Publications, 2002.
3. Joseph D. Bronzino,"The Biomedical Engineering –Handbook", CRC press.
4. Endarle, Blanchard &Bronzino,"Introduction to Biomedical Engg.", Academic press.
5. Anil Baran Singha Mahapatra,"Essential of Medical Physiology", Current Books International.

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Subject Code: BBE19E05	Subject Name : BIOMEMS		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: BIOMATERIALS & IMPLANTABLE DEVICES		T	3	0/0	0/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To understand the working principle of MEMS and Microsystems
- To understand the working of MOEMS Technology
- To understand the concepts of BioMEMS and its application in healthcare
- To give an insight to the DNA based BioMEMS
- To study about the BioMEMS with DNA

COURSE OUTCOMES (COs) : (3- 5)

CO1	understands the working principle of MEMS and Microsystems
CO2	understands the working of MOEMS Technology
CO3	understands the concepts of BioMEMS and its application in healthcare
CO4	Acquires knowledge on the DNA based BioMEMS
CO5	Acquires knowledge on the BioMEMS with DNA

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	L	L	M	H	L	M	H	L	M	H
CO2	H	H	H	L	L	M	H	M	H	L	M	H
CO3	M	H	L	M	H	L	M	H	L	M	H	L
CO4	H	M	L	M	H	L	M	H	L	M	H	L
CO5	L	M	H	L	M	H	L	M	H	L	M	H

COs / PSOs	PSO1	PSO2	PSO3		
CO1	M	L	H		
CO2	M	H	L		
CO3	H	H	H		
CO4	M	H	L		
CO5	L	M	M		

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

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BBE19E05	**BIOMEMS**	**3**	**0/0**	**0/0**	**3**

UNIT I   MEMS   9
Introduction - Typical MEMS Products - Application of Micro-system in Healthcare Industry – Working Principles of Microsystems Micro-sensors – Micro-actuation - MEMS with actuation– Micro-accelerators and Micro-fluidics - Materials for MEMS and Microsystems

UNIT II   MEMS AND MICROFLUIDICS   9
Fundamental principle - Light Modulators-Beam splitter – Micro-lens-Micro-mirrors - Digital Micro-mirror Device-Light detectors - Important Consideration on Micro-scale fluid-Properties of fluid - Fluid Actuation Methods – Micro-pumps - Typical Micro-fluidic Channel-Micro-fluid Dispenser.

UNIT III   BIOMEMS   9
Introduction -Principle of Biosensor-Ampero-metric Biosensor - Micro-dialysis - BioMEMS for Clinical Monitoring - Monitoring of Glucose and Lactate with a micro-dialysis probe – Ammonia Monitoring - Electronic Nose-DNA Sensors-

UNIT IV   BIOMEMSAND DNAI   9
Unique features of Nucleic Acids-Lab on the Chip-Electrophoresis-Polymerase Chain Reaction (PCR)-Biochemical reaction chains for integration: Biosensors and the "lab biochip"-

UNIT V   BIOMEMSAND DNAII   9
Typical Microarray experiment-Manufacturing of Microarrays-Synthesis on the chip-Spotting Techniques-PCR on the chip-Microchamber Chips-Micro-fluidics Chips-Emerging BioMEMS Technology.

Total No of Periods: 45

TEXT BOOKS:
1. Steven S-Saliterman, "Fundamentals of BioMEMS and Medical Microdevices", International Society for Optical Engineering, First Edition 2006.
2. NitaigourPremchandMahalik, "MEMS", Tata McGraw Hill, 2nd Reprint, 2008
3. Wanjun Wang and Steven A.Soper, "BioMEMS- Technologies and applications", CRC Press, First edition, 2007.

REFERENCE BOOKS:
1. Tai-Ran Hsu, "MEMS and Microsystems- Design- Manufacture and Nanoscale Engineering", John Wiley and Sons, 2nd Edition, 2008.
2. Gerald A Urban, "BioMEMS", Springer, First Edition, 2006.
3. Paul C.H. Li, "Introduction to Microfluids and BioMEMS: A Design and Problem-Solving Textbook", CRC Press, First Edition, 2009

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Subject Code: BBI18002	Subject Name : MEDICAL PHYSICS		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None		T	3	0/0	0/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- Introduction to Atomic Physics
- To understand the concept of Interactionwith Living Cells
- To provide the knowledge about the Effects of Radiation

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understands the concept of Atomic Physics
CO2	Capable to understand the concept of Interaction with Living Cells
CO3	The graduates attainknowledge about the Effects of Radiation

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	M	H	L	H	M	L	M	H	M	L
CO2	H	M	L	M	H	M	L	M	H	L	M	H
CO3	L	M	H	L	M	H	L	M	H	L	M	H
COs / PSOs	PSO1		PSO2		PSO3							
CO1	L		M		H							
CO2	M		H		M							
CO3	M		H		M							

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

UNIT I   ATOMIC PHYSICS   9
Traditional definition of atom-periodic system of elements-mechanical properties of atom-emission of light and its frequencies - Electromagnetic spectra - Principles of Nuclear Physics – Natural radioactivity-Decay series-type of radiation and their applications-artificially produced isotopes and its application-accelerator principles; Radio nuclides used in Medicine and technology.

UNIT II   INTERACTION WITH LIVING CELLS   9
Target theory-single hit and multi target theory-cellular effects of radiation-DNA damage-depression of Macro molecular synthesis-Chromosomal damage.

UNIT III   SOMATIC EFFECT OF RADIATION   9
Radio sensitivity protocol of different tissues in human-LD 50/30 effect of radiation on skin-blood forming organs-lenses of eye-embryo and Endocrinal glands.

UNIT IV   GENETIC EFFECT OF RADIATION   9
Threshold of linear dose effect-relationship-factors affecting frequency of radiation induced mutation-Gene controlled hereditary diseases-biological effect of microwave and RF wave. Variation in dielectric constant and specific conductivity of tissues - Penetration and propagation of signals effects in various vital organs- Protection standards

UNIT V   PHOTO MEDICINE   9
Synthesis of Vitamin D in early and late cutaneous effects-Phototherapy-Photo chemotherapy-exposure level-hazards and maximum permissible exposures - Laser physics – Characteristics of Laser radiation-Laser speckle-biological effects- laser safety management

Total No of Periods: 45

TEXT BOOKS:
1. Moselly, "Non ionizing Radiation", Adam HilgarBrustol, 1988.

REFERENCE BOOKS:
1. Branski.S and Cherski.P,"Biological effects of Microwave" Hutchinson and ROSS Inc. Strondsburg, 1980.
2. Glasser.O. "Medical Physics", Vol.1- 2- 3,Book Publisher Inc Chicago, 1980.

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Subject Code: BBE19E06	Subject Name : GENETIC ENGINEERING		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:		T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To understand the basics of genetics
- To understand the working of chromosomes
- To understand the concepts of alleles
- To give an insight to crossing over& gene transfer
- To study about the genetics and biotechnology

COURSE OUTCOMES (COs) : (3- 5)

CO1	understands the basics of genetics
CO2	understands the working of chromosomes
CO3	understands the concepts of alleles
CO4	Acquires knowledge on the crossing over& gene transfer
CO5	Acquires knowledge on the genetics and biotechnology

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	L	L	M	H	L	M	H	L	M	H
CO2	H	H	H	L	L	M	H	M	H	L	M	H
CO3	M	H	L	M	H	L	M	H	L	M	H	L
CO4	H	M	L	M	H	L	M	H	L	M	H	L
CO5	L	M	H	L	M	H	L	M	H	L	M	H
COs / PSOs	PSO1		PSO2		PSO3							
CO1	M		L		H							
CO2	M		H		L							
CO3	H		H		H							
CO4	M		H		L							
CO5	L		M		M							

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

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BBE19E06	GENETIC ENGINEERING	3	0/0	0/0	3

UNIT I BASICS OF GENETICS 9

Classical genetics- Mendelian Laws- Mendel's experiment-monohybrid cross-phenotype- genotype- Dihybrid inheritance- Interaction of genes- Fine structure of Genes

UNIT II CHROMOSOMES 9

Chromosome structure and organization in prokaryotes and eukaryotes- unusual chromosomes chromosome banding- chromosome abnormalities- genetic disorders

UNIT III ALLELES 9

Classical concepts of Pleomorphism- Multiple alleles- ABO blood groups- Rh factor- sex linkage in Drosophila- linkage in human beings- mechanism of sex determination- XX-XY mechanisms of sex determination- sex determination in Drosophila- environmental factors and sex determination- sex differentiation.

UNIT IV CROSSING OVER AND GENE TRANSFER 9

Coupling and Repulsion-Hypothesis- Test cross in maize and crossing over- theory of crossing over- molecular mechanism of crossing over- sex chromosomes and sex linked inherited disorders-colour blindness- hemophilia- Muscular dystrophy Transformation-Tansduction- Conjugation- Plasmids and Episomes

UNIT V GENETICS AND BIOTECHNOLOGY 9

Introduction- industrial genetics- protoplast and cell fusion technologies- genetic engineering- Introduction to Bio-informatics- potential lab biohazards of genetic engineering- Bioethics.

Total No of Periods: 45

TEXT BOOKS:
1. Gardner- Simmons and Snustad,"Principles of Genetics", John Wiley and Sons (Asia), 2002
2. Lewin, "Genes VIII", International Edition, Prentice Hall, 2004

REFERENCE BOOKS:
1. P.C. Winter- G.I. Hickey and H.L. Fletcher,"Instant Notes in Genetics", Viva Books Private Limited, 2003.

Subject Code: BBI18E09	Subject Name : BIOLOGICAL EFFECTS OF RADIATION		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: MEDICAL PHYSICS		T	3	0/0	0/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To Study about Actionof Radiation on Living Cells
- To Learn about Somatic Application of Radiation
- To Gain Knowledge on Genetic Effects of Radiation
- To Study about Effect of Microwave and RF With Matters
- To Gain Knowledge on UV Radiation

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understands action of Radiation on Living Cells
CO2	Capable to analyze Somatic Application of Radiation
CO3	Acquires Knowledge on Genetic Effects of Radiation
CO4	Understands Effect of Microwave and RF With Matters
CO5	Acquires Knowledge on UV Radiation

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	M	L	H	M	L	M	H	L	M	H
CO2	M	H	L	M	H	L	M	H	L	M	H	L
CO3	H	M	L	H	M	H	M	H	L	M	H	L
CO4	L	M	H	L	M	H	L	M	H	L	M	H
CO5	H	M	L	M	H	L	M	H	L	M	H	L

COs / PSOs	PSO1	PSO2	PSO3
CO1	M	H	L
CO2	H	M	H
CO3	L	M	H
CO4	H	L	M
CO5	M	L	H

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

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BBI18E09   BIOLOGICAL EFFECTS OF RADIATION   3   0/0   0/0   3

UNIT I   ACTION OF RADIATION ON LIVING CELLS   9
Various theories related to radiation at cellular level-DNA and chromosomal damages-experiments on computation of various parameters related to this radiation exposure

UNIT II   SOMATIC APPLICATION OF RADIATION   9
Radio sensitivity protocols of different issues of human-LA\D 50/30 effective radiation on skin-bone marrow-eye-endocrine glands-basis of radiotherapy.

UNIT III   GENETIC EFFECTS OF RADIATION   9
Thresholds and linear dose-gene control hereditary diseases-effect of dose and I Infleneceson genetic equilibrium.

UNIT IV   EFFECT OF MICROWAVE AND RF WITH MATTERS   9
Effects on various human organs and systems-wavelength in tissues-nonthermal interaction-low frequency radiation-measurement devices used to compute the thermal effects-standards of protection-national and international standards and precautions.

UNIT V   UV RADIATION   9
Classification of sources-measurement-photo medicine-UV radiation safety Visible and infrared radiation-combined effect of UV and IR-dose measuring instruments sed safety standards for this radiation

                                                            Total No of Periods: 45

TEXT BOOKS:
1. Glasser.O.,"Medical Physics",vol I-II-III,The year book Publishers Iinc., Chicago,1980.
2. Baranski.S and Cherski.P,"Biological effects of microwave",Hutchison and Ross Inc.-Stroudsburg,1980.

REFERENCE BOOKS:

1. Moselly.H, "Non-ionizing Radiation", Adam-Hilgar Bristol, 1988.

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Subject Code: BBI18E10	Subject Name : DRUG DELIVERY SYSTEMS		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None		T	3	0/0	0/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To educate the student on drug delivery system which would enable a comprehensive analysis
- Givedirection of these drug delivery systems as an important tool in improving the efficacy
- safety of the release of drugs in the body
- explores the present and future strategies within the drug delivery market.
- Understands Implementation of plans and method

COURSE OUTCOMES (COs) : (3- 5)

CO1	The graduate can know about drug delivery system which would enable a comprehensive analysis
CO2	Capable of giving these drug delivery systems as an important tool in improving the efficacy
CO3	Understands safety of the release of drugs in the body
CO4	Graduates can understand about present and future strategies within the drug delivery market.
CO5	Understands Implementation of plans and method

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	L	H	H	H	M	L	H	M	H	L
CO2	M	H	M	L	H	M	L	H	M	L	H	M
CO3	H	H	M	L	H	L	M	H	L	M	H	L
CO4	L	M	H	L	H	M	L	M	H	L	M	H
CO5	H	M	L	H	L	M	H	L	M	H	L	H

COs / PSOs	PSO1	PSO2	PSO3			
CO1	H	M	L			
CO2	M	H	L			
CO3	H	H	H			
CO4	M	M	H			
CO5	H	H	M			

H/M/L indicates Strength of Correlation   H- High- M- Medium- L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

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BBI18E10   **DRUG DELIVERY SYSTEMS**   **3   0/0   0/0   3**

UNIT I   SUSTAINED AND CONTROLLED DRUG DELIVERY   9
 Introduction- properties of drugs- Pharmacokinetic properties of drugs- sustained release formulations – concept- physicochemical biological properties of drugs- advantages and disadvantages – controlled drug delivery systems – automatically controlled drug delivery systems and their biomedical applications.

UNIT II   POLYMERS & TARGETTED DRUG DELIVERY SYSTEMS   9
 Polymers used in drug delivery systems – modules- classification- characterization- advantages and disadvantages of polymer- targeted drug delivery systems – concepts – nanoparticles – liposomes- microspheres – hydrogels

UNIT III   TRANSDERMAL DRUG DELIVERY SYSTEMS   9
Transdermal penetration of drugs – formulation – addition – polymers in transdermal drug delivery system – iontophoresis – transdermal controlled release products and devices

UNIT IV   IMPLANTABLE DRUG DELIVERY SYSTEMS   9
Implantable micro – pump systems – peristaltic micro pump – osmotic micro pump - diaphragm micro pump – Fluorocarbon propellent driven micro pump – solenoid driver reciprocates micro pump – programmable implanted drug administrative device (DAD)

UNIT V   SITE SPECIFIC DRUG DELIVERY SYSTEMS   9
Development in insulin therapy using biomedical controlled drug delivery systems – drug delivery using monoclonal antibodies – role of biosensors and transducers in diagnostic

Total No of Periods: 45

TEXT BOOKS:
1. Vyas S. P. Khar R K,"Targetted and controlled drug delivery Novel Carrier System CBSPD", 2006.
2. Anya M Hillery et al., "Drug delivery and targeting", CRC press, 2000

REFERENCE BOOKS:
1. Robinson R Robinson,"Conventional drug delivery systems", CRC press, 2004

Subject Code: BBI18E15	Subject Name : HOSPITAL MANAGEMENT		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None		T	3	0/0	0/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To Learn about need and scopes of clinical engineering
- To gain knowledge on training and management of technical staff in hospital
- To study about training and management of technical staff in hospital
- To learn about standards and codes in health care
- To gain knowledge on computer in medicine

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understands need and scopes of clinical engineering
CO2	Acquires training and management of technical staff in hospital
CO3	Graduate understands training and management of technical staff in hospital
CO4	Understands standards and codes in health care
CO5	Understands computer in medicine

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	M	L	H	L	M	H	L	M	H	L
CO2	M	H	L	M	H	L	M	H	L	M	H	L
CO3	M	H	L	M	H	L	M	H	L	M	H	L
CO4	M	H	L	M	L	M	H	L	M	H	L	M
CO5	M	H	L	M	H	L	M	H	L	M	H	L
COs / PSOs	PSO1		PSO2		PSO3							
CO1	M		H		L							
CO2	M		H		L							
CO3	H		M		L							
CO4	L		M		H							
CO5	H		M		L							

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

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BBI18E15	HOSPITAL MANAGEMENT	3	0/0	0/0	3

UNIT I   NEED AND SCOPES OF CLINICAL ENGINEERING   9

Clinical engineering program- educational responsibilities- role to be performed by them in hospital- staff structure in hospital

UNIT II   NATIONAL HEALTH POLICIES   9

Need for evolving health policy- health organization in state- health financing system- health education- health insurance- health legislation

UNIT III   TRAINING AND MANAGEMENT OF TECHNICAL STAFF IN HOSPITAL   9

Difference between hospital and industrial organization- levels of training- steps of training- developing training program- evaluation of training- wages and salary- employee appraisal method.

UNIT IV   STANDARDS AND CODES IN HEALTH CARE   9

Necessity for standardization- FDA- Joint Commission of Accreditation of hospitals- ICRP and other standard organization- methods to monitor the standards.

UNIT V   COMPUTER IN MEDICINE   9

Computer application in ICU- X-Ray department- laboratory administration- patient data- medical records- communication- simulation.

Total No of Periods : 45

TEXT BOOKS:
1. Webster J.C. and Albert M.Cook, "Clinical Engineering Principle and Practice", Prentice Hall Inc., Englewood Cliffs, New Jersey- 1979.

REFERENCE BOOKS:
1. Goyal R.C., "Handbook of hospital personal management", Prentice Hall of India, 1996.

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Subject Code: BBE19E07	Subject Name : CLINICAL OBSERVATION AND NEEDS FINDING	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To learn about Hospital Organization and the Role of Clinical Engineering.
- Technology Planning- Technology Assessment.
- To learn about Quality Improvement
- To learn about Standards
- To learn about virtual instruments

COURSE OUTCOMES (COs) : (3- 5)

CO1	Get a clear view of hospital organization and the role of clinical observation.
CO2	Get a clear view of the health care delivery system- strategic technology planning-technology assessment.
CO3	Know about quality improvement- standard database- measurement indicators.
CO4	Get a clear view Deming's 14 Points- Zero Defects- TQM (Total Quality Management)and tools
CO5	Learn about quality improvement- standard database- measurement indicators.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	M	L	M	H	H	M	L	M	L	M
CO2	M	H	L	L	L	M	H	M	H	M	H	H
CO3	L	M	H	M	H	L	H	H	H	L	M	H
CO4	H	H	H	H	M	M	L	H	M	L	L	L
CO5	L	L	M	H	H	M	L	M	H	M	M	L

COs / PSOs	PSO1	PSO2	PSO3			
CO1	H	H	M			
CO2	M	H	H			
CO3	H	L	H			
CO4	L	L	H			
CO5	M	M	L			

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

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BBE19E07	CLINICAL OBSEVATION AND NEEDS FINDING	3	0/0	0/0	3

UNIT I   CLINICAL OBSERVATION   9
Definition- Evolution of Clinical Engineering – interactions of a clinical engineer – HospitalOrganization and the Role of Clinical Engineering- Clinical Engineering Programs

UNIT II   MANAGEMENT AND ASSESSMENT OF MEDICAL TECHNOLOGY ANDRISK FACTORS   9
The Health Care Delivery System- Strategic Technology Planning- Technology Assessment-Equipment Assets Management. Risk Management – Strategies- Risk Management:
Application

UNIT III   QUALITY OF IMPROVEMENT AND TEAM BUILDING   9
Deming's 14 Points- Zero Defects- TQM (Total Quality Management) and Tools Used forQuality Improvement- Standard Database- Measurement Indicators.

UNIT IV   STANDARD   9
Standards Regulatory and Assessment Agencies- Standards for clinical Engineers- RegulatoryAgencies- Technology Assessment Agencies

UNIT V   APPLICATIONS OFVIRTUAL INSTRUMENTS IN HEALTH CARE   9
Application with Examples- Trending- Relationships- and Interactive Alarms- DataModeling- Medical Equipment Risk Criteria- Peer Performance Reviews.

Total No of Periods: 45

TEXT BOOKS:
1. Joseph Bronzino,"Handbook of Biomedical Engineering", 2000.

REFERENCES BOOKS:
1. Joseph Bronzino, "Principles of Biomedical Engineering".

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Subject Code: BBE19E08	Subject Name:TELE HEALTH TECHNOLOGY		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:		T	3	0/0	0/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- The students should be made to Learn the key principles for Telemedicine and health
- Understand Telemedical technology.
- Understand ethical and legal aspects of Telemedicine
- Know Telemedical standards- mobile Telemedicine.
- Application of Telemedicine

COURSE OUTCOMES (COs) : (3- 5)

CO1	Ability to analyzethe principle for Telemedicine
CO2	Ability to use the technology for Telemedicine
CO3	Ability to analyzeEthical and Legal aspects of Telemedicine
CO4	Gain knowledge about Telemedicine standards - mobile Telemedicine
CO5	Understands and apply the Telemedicine

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	L	H	M	H	M	L	M	H
CO2	M	H	M	L	H	M	H	M	H	M	H	H
CO3	L	H	H	H	M	L	H	M	M	L	M	M
CO4	M	H	H	M	M	M	M	H	H	M	L	M
CO5	L	M	L	M	H	M	L	M	L	M	M	L

COs / PSOs	PSO1	PSO2	PSO3					
CO1	H	H	M					
CO2	M	H	M					
CO3	H	L	H					
CO4	H	L	H					
CO5	M	L	L					

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

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BBE19E08 **TELE HEALTH TECHNOLOGY** **3** **0/0** **0/0** **3**

UNIT I FUNDAMENTALS OF TELEMEDICINE 9
History of telemedicine- definition of telemedicine- tele-health- tele-care- scope- Telemedicine Systems- benefits & limitations of telemedicine.

UNIT II TYPE OF INFORMATION & COMMUNICATION INFRASTRUCTURE FOR TELEMEDICINE 9
Audio- video- still images- text and data- fax-type of communications and network: PSTN- POTS- ANT- ISDN- internet- air/ wireless communications- GSM satellite- micro wave- Mobile health and ubiquitous healthcare.

UNITIII ETHICALAND LEGAL ASPECTS OFTELEMEDICINE 9
Confidentiality- patient rights and consent: confidentiality and the law- the patient-doctor relationship- access to medical records- consent treatment - data protection & security- jurisdictional issues- intellectual property rights.

UNIT IV PICTURE ARCHIVING AND COMMUNICATION SYSTEM 9
Introduction to radiology information system and ACS- DICOM- PACS strategic plan and needs assessment- technical Issues- PACS architecture.

UNIT V APPLICATIONS OF TELEMEDICINE 9
Teleradiology- telepathology- telecardiology-tele oncology-tele dermatology- telesurgery- e Health and Cyber Medicine.

Total No of Periods: 45

TEXT BOOKS:
1. Norris A C, "Essentials of Telemedicine and Telecare‖", John Wiley, New York, 2002.
2. H K Huang,"PACS and Imaging Informatics: Basic Principles and Applications‖", Wiley- New Jersey, 2010.

REFERENCE BOOKS:
1. Olga Ferrer Roca, Marcelo Sosa Iudicissa, "Handbook of Telemedicine‖", IOS Press, Netherland, 2002.
2. Khandpur R S,"Handbook of Biomedical Instrumentation‖", Tata McGraw Hill, New Delhi, 2003.
3. Keith J Dreyer, Amit Mehta, James H Thrall Pacs, "A Guide to the Digital Revolution‖", Springer, New York, 2002.
4. Khandpur R S,"TELEMEDICINE- Technology and Applications‖", PHI Learning Pvt Ltd., Newdelhi, 2017.

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Subject Code: BBE19E09	Subject Name ROBOTICS IN MEDICINE		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:		T	3	0/0	0/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- The student should be made to Understand the basics of Robotics- Kinematics
- Understand the basics of Inverse Kinematic
- Explore various kinematic motion planning solutions for various Robotic configurations.
- Explore planning of Robots in Medicine.
- Design Robotic systems for Medical application.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Ability to understand the basics of Robotics
CO2	Ability to use the technology of Kinetics for Robotics
CO3	Ability to analyze kinematics motion for various Robotics configuration
CO4	Gain knowledge about planning of Robotics
CO5	Understands and apply the Robotics system in medical application

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	L	H	M	H	M	L	M	H
CO2	M	H	M	L	H	M	H	M	H	M	H	H
CO3	L	H	M	H	M	L	H	H	H	L	M	H
CO4	H	M	L	H	H	M	L	M	M	H	L	M
CO5	L	M	H	M	H	M	L	M	H	M	M	L

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	M
CO2	M	H	M
CO3	H	M	L
CO4	L	H	H
CO5	M	M	L

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

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BBE19E09	**ROBOTICS IN MEDICINE**	3	0/0	0/0	3

UNIT I INTRODUCTION 9

Introduction Automation and Robots- Classification- Application- Specification- Notations- Direct Kinematics Dot and cross products- Coordinate frames- Rotations- Homogeneous coordinates Link coordination arm equation – Five-axis robot- Four-axis robot- Six-axis robot

UNIT II KINEMATICS 9

Inverse Kinematics – General properties of solutions tool configuration- Five axis robots- ThreeFour axis- Six axis Robot- Workspace analysis and trajectory planning work envelope and examples- workspace fixtures- Pick and place operations- Continuous path motion- Interpolated motion- Straight-line motion.

UNIT III ROBOT VISION 9

Robot Vision Image representation- Template matching- Polyhedral objects- Shane analysis- Segmentation – Thresholding- region labeling- Shrink operators- Swell operators- Euler numbers- Perspective transformation- Structured illumination- Camera calibration.

UNIT IV PLANNING 9

Task Planning Task level programming- Uncertainty- Configuration- Space- Gross motion- Planning- Grasp Planning- Fine-motion planning- Simulation of planar motion- Source and Goal scenes- Task Planner simulation.

UNIT V APPLICATIONS 9

Applications in Biomedical Engineering – Bio Engineering Biologically Inspired Robots- Neural Engineering- Application in Rehabilitation – Interactive Therapy- Bionic Arm- Clinical and Surgical – Gynaecology- Orthopaedics- Neurosurgery

Total No of Periods: 45

TEXT BOOKS:
1. Robert Schilling, "Fundamentals of Robotics-Analysis and control‖", Prentice Hall- 2003.
2. J.J.Craig, "Introduction to Robotics‖", Pearson Education, 2005.

REFERENCES:
1. Staugaard Andrew C, "Robotics and Artificial Intelligence: An Introduction to Applied Machine Learning‖", Prentice Hall Of India, 1987.
2. Grover Wiess, Nagel Oderey, "Industrial Robotics: Technology- Programming and Applications‖", McGraw Hill, 1986.
3. Wolfram Stadler,"Analytical Robotics and Mechatronics‖", Tata McGraw Hill, 1995.

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Subject Code: BBI18E13	Subject Name : BIOMATERIALS AND ARTIFICIAL ORGANS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	T	3	0/0	0/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To know about the different classes of materials used in medicine
- To gain knowledge about the application of biomaterials in medicine
- To understand the concept of biocompatibility and the methods of biomaterial testing
- To know about the technologies of biomaterial processing-clinical trials-ethical issues and regulatory standards.
- To gain knowledge in some of the existing designs of artificial organs.

COURSE OUTCOMES (COs) : (3- 5)

CO1	The graduate understands about the different classes of materials used in medicine
CO2	Familiar with the application of biomaterials in medicine
CO3	Graduate understands the concept of biocompatibility and the methods of biomaterial testing
CO4	The graduate will be able to use technologies of biomaterial processing-clinical trials-ethical issues and regulatory standards.
CO5	Acquires knowledge in some of the existing designs of artificial organs.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	H	L	M	H	L	M	H	M	L	M
CO2	H	M	H	M	L	M	H	L	H	M	H	M
CO3	H	L	M	M	L	H	M	L	H	M	L	M
CO4	H	M	L	H	M	L	H	M	L	M	H	L
CO5												

COs / PSOs	PSO1	PSO2	PSO3									
CO1	M	H	M									
CO2	H	M	L									
CO3	H	M	M									
CO4	M	L	H									
CO5	M	H	L									

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

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BBI18E13   BIOMATERIALS AND ARTIFICIAL ORGANS   3   0/0   0/0   3

UNIT I   STRUCTURE OF BIO-MATERIALS AND BIO-COMPATIBILITY   9
Definition and classification of bio-materials-mechanical properties-visco elasticity-wound-healing process-body response to implants- blood compatibility

UNIT II   IMPLANT MATERIALS   9
Metallic implant materials-stainless steels-co-based alloys-Ti-based alloys-ceramic implant materials-aluminum oxides-hydroxyapatite glass ceramics carbons-medical applications.

UNIT III   POLYMERIC IMPLANT MATERIALS   9
Polymerization-polyolefin-polyamicles-Acryrilic-polymers-rubbers-high strength thermoplastics- medical applications

UNIT IV   TISSUE REPLACEMENT IMPLANTS   9
Soft-tissue replacements-sutures-surgical tapes-adhesive-percutaneous and skin implants-maxillofacial augmentation-blood interfacing implants-hard tissue replacement implants-internal fracture fixation devices-joint replacements.

UNIT V   ARTIFICIAL ORGANS   9
Artificial Heart-Prosthetic Cardiac Valves-Limb prosthesis-Externally Powered limb Prosthesis-Dental Implants

Total No of Periods: 45

TEXT BOOKS:
　　　1. PARK J.B.,"Biomaterials Science and Engineering",Plenum Press,1984.

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

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Subject Code: BBI18E14	Subject Name :RECENT ADVANCES APPLIED TO HOSPITAL ENGINEERING	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	T	3	0/0	0/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To learn about Standardization Of Hospital Equipment's
- To gain knowledge on Clinical Engineering
- To study about Networking
- To gain knowledge on Fibre Optic Sensors for Measuring Physiological Parameters
- To learn about Emi and Emc Applied to Hospital Equipment's

COURSE OUTCOMES (COs) : (3- 5)

CO1	Acquires knowledge on Standardizationof Hospital Equipment's
CO2	Gains knowledge on Clinical Engineering
CO3	Graduate understands Networking
CO4	Gains knowledge on Fibre Optic Sensors for Measuring Physiological Parameters
CO5	Acquires knowledge EMI and EMC Applied to Hospital Equipment's

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	L	M	L	M	H	L	M	H	L	M
CO2	M	L	H	M	L	M	H	L	M	H	L	M
CO3	L	M	H	L	M	H	L	M	H	L	M	H
CO4	H	M	L	M	H	L	M	H	L	M	H	L
CO5	M	H	L	M	H	L	M	H	L	M	H	L

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	M	L
CO2	M	H	L
CO3	L	M	H
CO4	M	H	L
CO5	H	M	M

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

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BBI18E14   **RECENT ADVANCES APPLIED TO HOSPITAL**   **3   0/0   0/0   3**
ENGINEERING

UNIT I   STANDARDISATION OF HOSPITAL EQUIPMENTS   9
Need for standardization-classification of equipment's-international standards-Experimental methods of testing standards-maintenance of standards and recalibration.

UNIT II   CLINICAL ENGINEERING   9
Hospital design-electrical-air – conditioning-sanitation-ventilation-safety regulation to be incorporated in the hospital center-management and legal aspects-latest rug delivery systems for sustained delivery of medicines.

UNIT III   NETWORKING   9
Importance of networking-LAN features-network topologies-LAN components-network operating system-basic data communication concept-application-LAN and multi-user system-planning and installing LAN in hospital set up.

UNIT IV   FIBRE   OPTIC   SENSORS   FOR   MEASURING   PHYSIOLOGICAL
PARAMETERS   9
Different optical sources-optical detectors-principle of fiber optic cables-single mode multi-mode-step index and graded index type-sensors based on polarization-interferometer principle-magnetic sensors-application of the sensors in measuring pressure-temperature-flow-rotation and chemical activates-principles of smart sensors.

UNIT V   EMI AND EMC APPLIED TO HOSPITAL EQUIPMENTS   9
Principles of EMI-computation of EMI-measuring techniques to quantify the level of interference-method of suppressing and isolating this unit from interference

                                                        Total No of Periodss: 45

TEXT BOOKS:
1. Donald R.J. White,"A Handbook of electromagnetic Interference and Compatibility", Vol 4- 5, Published by Donwhite Constant, Maryland 1972.
2. Webster J.G. and Albert M. Cook,"Clinical Engineering Principles and Practices",Printice Hall Inc., Englewood Cliffs, New Jersery, 1979.
3. Bernhard Keiser,"Principles of Eletromagnetic Compatibility", Artech House, 3rd Edition, 1986.

REFERENCE BOOKS:
1. Eric Udd,"Fiber Optic Sensors and introduction for engineers and scientists", Wiley Interscience Publication, New Delhi, 1991.
2. Bajbai P.K. Ceramic, "a novel device for sustained long term delivery of drugsBio Ceramic", Vol III, Rose Heliman Institute of Technology,Terrahaute, India, 1992.
3. S.K. Basandia,"Local Area Network", Golgotia Publishing Pvt Ltd., New Delhi, 1995.

Subject Code: BBE19E10	Subject Name: CELLULAR AND MOLECULAR NETWORKS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To occur knowledge about molecular diagnostics.
- To study and analyze about cellular complexity.
- To study about Molecular oncology mitochondrial disorders.
- To study about Biomarkers in disease diagnostics.
- To analyze Chromosomes- human disorders and cytogenetic analysis

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the molecular diagnostics.
CO2	Analyze the cellular complexity.
CO3	Occur knowledge about mitochondrial disorders in molecular.
CO4	Disease diagnostics in Biomarkers.
CO5	Identify the chromosomes - human disorders and cytogenetic.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	L	H	M	H	M	L	M	H
CO2	M	H	M	L	H	L	M	M	H	M	H	H
CO3	L	M	H	M	M	L	H	L	H	L	M	H
CO4	M	H	L	M	H	M	L	M	M	M	L	M
CO5	L	M	H	M	H	M	L	M	H	M	M	L

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	M	H
CO2	M	M	L
CO3	H	H	M
CO4	M	H	M
CO5	M	L	L

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

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BBE19E10   CELLULAR AND MOLECULAR NETWORKS   3   0/0   0/0   3

UNIT I   INTRODUCTION TO MOLECULAR DIAGNOSTICS   9
History of diagnostics- Age of molecular diagnostics- Significance- Scope- Rise of diagnostic industry in Indian and global Scenario.

UNIT II   CELLULAR COMPLEXITY   9
Cell components- Cell Differentiation- Cellular communication – endocrine signaling- paracrine signaling and autocrine signaling- contact dependent and synaptic communications Intracellular networks – transport pathways-signaling pathways and metabolic networks. Eukaryotic Cell Control System and their Components- Intracellular cell cycles control system- Extracellular Cell Cycle Control System- Regulation of Cell Growth and Apoptosis.

UNIT III   MOLECULAR ONCOLOGY MITOCHONDRIAL DISORDERS   9
Cancer -Benign and Malignant neoplasms- multifactorial disposition- Cancer pathogenesis- positive and negative mediators of neoplastic development- Proto-oncogenes- Oncogenes and Tumor suppressors.Allele loss and loss of Heterozygosity=Mitochondrial inheritance- Mitochondrial myopathy-lactic acidosis- MELAS- LHONs- identity testing.

UNIT IV   BIOMARKERS IN DISEASE DIAGNOSTICS   9
FDA definition of disease markers- Role of markers in Disease diagnosis. Approaches and methods in the identification of disease markers- predictive value- diagnostic value- emerging blood markers for sepsis-tumourand cancer markers- markers in inflammation and diagnosis of cytoskeletal disorders.

UNIT V   CHROMOSOMES- HUMAN DISORDERS- AND CYTOGENETIC ANALYSIS   9
Structure- types and organization; Chromosome organization- Euchromatin and heterochromatin and Histone modifications. Chromosome banding and nomenclature; Nomenclature and functional significances of chromosome bands. GC and AT rich isochores. Structural and Numerical aberrations and its consequences. X-chromosome dosage compensation and inactivation mechanism. Sex determination and Y chromosome; function- and diseases.

Total No of Periods: 45

TEXT BOOKS:
1. Bruce Alberts,"Molecular biology of the cell", 6th Edition.
2. Robert Lanza,"Principles of tissue engineering", Elsevier Publications.
3. Ravi Birla,"Introduction to Tissue engineering- applications and challenges", Wiley Publications.

REFERENCES BOOKS:
1. Pasternak et al.,"Animal cell culture: An introduction to Human Molecular Genetics", John Wiley & Sons.
2. Miller & Tharman,"Human Chromosomes", Springer Publishing Company
3. Alberts et al.,"Molecular Biology of the cell", Garland Press.

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Subject Code: BBE19E11	Subject Name : BIOMEDICAL COMPUTING		T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:		T	3	0/0	0/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To acquire knowledge in Fuzzy sets
- To learn optimization analysis
- To learn about soft computing techniques Neutral network
- To learn about fuzzy interface.
- To implement the soft computing techniques in biomedical engineering

COURSE OUTCOMES (COs) : (3- 5)

CO1	Ability to analysis the fuzzy sets.
CO2	Gain knowledge about optimization analysis.
CO3	Understand neutral network.
CO4	Gain knowledge in interface systems.
CO5	Apply the soft techniques in application of bio medial engineering.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	H	M	H	M	M	H	M	H	M	H
CO2	H	M	M	M	M	H	H	M	H	M	H	M
CO3	M	H	H	H	H	M	M	H	M	H	M	H
CO4	M	M	M	M	M	H	M	M	H	M	H	M
CO5	M	H	H	H	H	M	H	H	M	H	M	M

COs / PSOs	PSO1	PSO2	PSO3
CO1	M	M	H
CO2	H	H	M
CO3	M	M	H
CO4	M	M	M
CO5	H	H	M

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

B.Tech. –Biomedical Engineering (2018 Regulations)

| BBE19E11 | BIOMEDICAL COMPUTING | 3 | 0/0 | 0/0 | 3 |

UNIT I INTRODUCTION TO FUZZY 9

Fuzzy Sets – Basic Definition and Terminology – Set-theoretic Operations – Member Function Formulation and Parameterization – Fuzzy Rules and Fuzzy Reasoning – Extension Principle and Fuzzy Relations – Fuzzy If-Then Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Models – Sugeno Fuzzy Models – Input Space Partitioning and Fuzzy Modeling.

UNIT II OPTIMIZATION ANALYSIS 9

Optimization - Derivative-based Optimization – Descent Methods – The Method of Steepest Descent – Classical Newton's Method – Step Size Determination – Derivative-free Optimization – Genetic Algorithms – Simulated Annealing – Random Search – Downhill Simplex Search.

UNIT III INTRODUCTION TO NEURAL NETWORKS 9

Supervised Learning Neural Networks – Perceptron's - Adaline – Backpropagation MultilayerPerceptron's – Radial Basis Function Networks – Unsupervised Learning Neural Networks – Competitive Learning Networks – KohonenSelf Organizing Networks – Learning Vector Quantization – Hebbian Learning.

UNIT IV FUZZY INTERFACE SYSTEMS 9

Adaptive networks based Fuzzy interface systems - Classification and Regression Trees - Data clustering algorithms - Rule based structure identification - Neuro-Fuzzy controls - Simulated annealing – Evolutionary computation.

UNIT V APPLICATIONS 9

Pattern Recognitions- Image Processing- Biological Sequence Alignment and Drug Design- Robotics and Sensors- Information Retrieval Systems- Natural Language Processing.

Total No of Periods: 45

TEXT BOOKS:
1. S.Rajasekaran and G.A.V.Pai, "Neural Networks- Fuzzy Logic and Genetic Algorithms", PHI-2003.
2. Davis E.Goldberg, "Genetic Algorithms: Search- Optimization and Machine Learning", Addison Wesley- N.Y. 1989.

REFERENCE BOOKS:
1. Timothy J.Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill 1997.
2. J.S.R.Jang,C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI2004.
3. R.Eberhart P.Simpson and R.Dobbins, "Computational Intelligence - PC Tools", AP Professional- Boston, 1996.

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Subject Code: BBE19E12	Subject Name: STEM CELLS AND REGENERATIVE TECHNOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial   SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
- To study the history and introduction to stem celland Regenerative medicine.
- To study the techniques used in stem cell biology.
- To occur knowledge in types of stem cells.
- Guidelines about the stem cells research and therapy in India.
- To study about the Degenerative diseases cell replacement and regeneration.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the stem cells and regenerative medicine.
CO2	Analyze the techniques used in stem cells.
CO3	Knowledge about the types of stem cells.
CO4	Knowledge about stem cell research and therapy in India.
CO5	Knowing about the degenerative diseases - cell replacement.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	L	H	M	L	H	M	H	M	M	L
CO2	L	M	M	M	L	H	H	L	M	H	L	M
CO3	H	M	L	H	M	L	L	M	H	L	M	H
CO4	H	H	L	L	H	M	M	M	H	M	L	M
CO5	M	L	M	H	H	M	L	M	H	M	M	L

COs / PSOs	PSO1	PSO2	PSO3
CO1	M	M	H
CO2	H	M	L
CO3	M	H	M
CO4	H	H	M
CO5	M	M	L

H/M/L indicates Strength of Correlation   H- High-M- Medium-L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

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| BBE19E12 | STEM CELLS AND REGENERATIVE TECHNOLOGY | 3 | 0/0 | 0/0 | 3 |

UNIT I HISTORY AND INTRODUCTION TO STEM CELL BIOLOGY AND REGENERATIVE MEDICINE 9

Terms: stem cell-progenitor cells- precursor cells- transit amplifying cells - General properties of stem cells. Terms: Totipotent- pluripotent- multipotent- unipotent stem cells - Differentiation and trans differentiation. Stem cell niche- growth and differentiation factors.

UNIT II TECHNIQUES USED IN STEM CELL BIOLOGY 9

Lineage – tracing technique- gene knock-out and knock-in studies- inducible gene expression or repression- transfection- DNA sequencing- Chromatin immunoprecipitation- fluorescent-activated cell sorting- confocal microscopy. Other techniques.

UNIT III STEM CELL TYPES 9

Embryonic stem cells- somatic cell nuclear transfer- induced pluripotent stem cells- neural stem cells- hematopoietic stem cells- pancreatic stem cells. Isolation and culture of the above stem cell types.

UNIT IV GUIDELINES FOR STEM CELLS RESEARCH AND THERAPY IN INDIA 9

Introduction- general mechanisms- aim and scope- categorization of research on stem cells- clinical application of umbilical cord blood stem cells- criteria on use of placental / fetal stem cells for research- approval of procurement. Banking or distribution of hESCs. International collaboration and patent issues.

UNIT V DEGENERATIVE DISEASES CELL REPLACEMENT AND REGENERATION 9

Discussion of degenerative diseases including Parkinson disease- diabetes- burn- retinal replacement therapy- cardiomyopathies- etc. Understanding of Application of stem cells in degenerative medicine. Cells and tissue engineering. Application of different stem cell types for different degenerative diseases including gene therapy.

Total No of Periods: 45

TEXT BOOKS:
1. Stewart Sell,"Methods in Molecular Biology: Basic Cell Culture Protocols", Stem Cells Handbook. Editor:. Humana Press.
2. Ann Kiessling and Scott C. Anderson,"Human Embryonic Stem Cells: An Introduction to the Science and Therapeutic Potential", Jones and Bartlett Publishers.

REFERENCE BOOKS:
1. Stem Cells and the Future of Regenerative Medicine. Committee on the Biological andApplications of Stem Cell Research, Board on Life Sciences, National Research Council, Board on Neuroscience and Behavioral Health- Institute of Medicine. National Academies Press.
2. Daniel R. Marshak- Richard L. Gardner and David Gottlieb, "Stem Cell Biology", Cold Spring Harbor Laboratory Press.
3. Ian Wilmut,"Essentials of Stem Cell Biology", Edited by. Elsevier publication.