Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Biomedical Engineering

(Applicable from the academic session 2018-2019)

Curriculum Structure

Second Year Third Semester							
Sl No.	**Category**	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**Credits**
Theory							
1	BS	BS - M301	Mathematics - III	3	1	0	4
2	ES	ES – EC 301	Analog Electronic Circuits	3	1	0	4
3	PC	PC – BME 301	Anatomy & Physiology	3	0	0	3
4	PC	PC – BME 302	Biophysics & Biochemistry	3	0	0	3
5	PC	PC – BME 303	Biosensor & Transducers	3	0	0	3
6	HM	HM – HU 301	Technical English	2	0	0	2
	Total Theory			**17**	**2**	**0**	**19**
Practical							
7	HM	HM – HU 391	Interpersonal Skill & Report Writing	0	0	2	1
8	ES	ES – EC 391	Analog Electronic Circuits Lab	0	0	2	1
9	PC	PC – BME 391	Physiology & Biochemistry Lab	0	0	2	1
10	PC	PC – BME 392	Biosensor & Transducers Lab	0	0	2	1
	Total Practical			**0**	**0**	**8**	**4**
			Total of First Semester	**17**	**2**	**8**	**23**

Second Year Fourth Semester							
Sl No.	**Category**	**Subject Code**	**Subject Name**	**Total Number of contact hours**			**Credits**
				L	**T**	**P**	
Theory							
1	BS	BS – M401	Numerical Methods	3	0	0	3
2	ES	ES – EC 401	Digital Electronics & Integrated Circuits	3	1	0	4
3	PC	PC – BME 401	Biomedical Instrumentation	3	1	0	4
4	PC	PC – BME 402	Analytical & Diagnostic Equipment	3	0	0	3
5	Professional Elective - I	PE – EC 402	Fundamental of Signals & Systems	2	1	0	3
		PE – EE 401	Electronic & Electrical Measurement				
		PE – EE 402	Circuit Theory & Network				
6	Open Elective - I	OE – BME 403	Telehealth Technology	2	1	0	3
		OE – BME 404	Virtual Instrumentation Design for medical System				
	Total Theory			**16**	**4**	**0**	**20**
Practical							
1	BS	BS – M492	Numerical Methods Lab	0	0	2	1
2	ES	ES – EC 491	Digital Electronics & Integrated	0	0	2	1

			Circuits Lab				
3	PC	PC – BME 491	Biomedical Instrumentation Lab	0	0	2	1
4	Professional Elective – I Lab	PE – EC 492	Signal Analysis using MATLAB	0	0	2	1
		PE – EE 491	Electronic & Electrical Measurement Lab				
		PE – EE 492	Circuit Theory & Network Lab				
	Total Practical			**0**	**0**	**8**	**4**
			Total of Second Semester	**16**	**4**	**8**	**24**

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Biomedical Engineering

(Applicable from the academic session 2018-2019)

Third Year Fifth Semester

Sl. No.	Category	Subject Code	Subject Name	Total Number of contact hours			Credits
				L	T	P	
Theory							
1	HM	HM – HU 501	Professional Ethics in Engineering	3	0	0	3
2	PC	PC – BME 501	Biomaterials & Tissue Engineering	3	1	0	4
3	PC	PC – BME 502	Biomechanics & Implants	3	1	0	4
4	PC	PC – BME 503	Medical Imaging Techniques	3	0	0	3
5	PC	PC – BME 504	Biomedical Signal Processing	3	1	0	4
6	Open Elective - II	OE – CS 501	Data Structure & Algorithms	3	1	0	4
		OE – CS 502	Object Oriented Programming & JAVA				
		OE – CS 503	DBMS				
	Total Theory			**18**	**4**	**0**	**22**
Practical							
7	PC	PC – BME 591	Biomaterials & Biomechanics Lab	0	0	2	1
8	PC	PC – BME 592	Biomedical Signal Processing Lab	0	0	2	1
9	Open Elective – II Lab	OE – CS 591	Data Structure & Algorithms Lab	0	0	2	1
		OE – CS 592	Object Oriented Programming & JAVA Lab				
		OE – CS 593	DBMS Lab				
	Total Practical			**0**	**0**	**6**	**3**
			Total of Third Semester	**18**	**4**	**6**	**25**

Third Year Sixth Semester

Sl. No.	Category	Subject Code	Subject Name	Total Number of contact hours			Credits
				L	T	P	
Theory							
1	HM	HM – HU 601	Industrial Management	3	0	0	3
2	PC	PC – BME 601	Therapeutic Equipment	3	0	0	3
3	PC	PC – BME 602	Advanced Medical Imaging Techniques	3	0	0	3
4	Professional Elective - II	PE – BME – 603	Artificial Organs & Rehabilitation Engineering	3	0	0	3
		PE – BME – 604	LASER & Fiber Optics in Medicine				
5	Professional Elective - III	PE – EC – 601	Microprocessors & Microcontrollers	3	1	0	4
		PE – EC – 602	VLSI				
		PE – BME – 605	Embedded Systems in Medicine				
6	Open Elective - III	OE – BME 606	Bio-control System	3	0	0	3
		OE – BME 607	Physiological Modeling				
		OE – BME 608	Biomedical MEMS & Nanotechnology				
	Total Theory			**18**	**1**	**0**	**19**
Practical							

7	PC	PC – BME 691	Medical Equipment Lab	0	0	2	1
8	PC	PC – BME 692	Medical Instruments & Systems Lab	0	0	2	1
9	Professional Elective – III Lab	PE – EC – 691	Microprocessors & Microcontrollers Lab	0	0	2	1
		PE – EC – 692	VLSI Lab				
		PE – BME – 693	Embedded Systems in Medicine Lab				
	Total Practical			**0**	**0**	**6**	**3**
			Total of Fourth Semester	**18**	**1**	**6**	**22**

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Biomedical Engineering

(Applicable from the academic session 2018-2019)

Fourth Year Seventh Semester

Sl. No.	Category	Subject Code	Subject Name	Total Number of contact hours			Credits
				L	T	P	
Theory							
1	PC	PC – BME 701	Medical Image Processing & Analysis	3	1	0	4
2	Professional Elective - IV	PE – BME – 702	Hospital Engineering & Informatics System	3	0	0	3
		PE – BME – 703	Health Technology Management				
		PE – BME – 704	Hospital Safety & Management				
		PE – BME – 705	Sports Medicine				
3	Open Elective - IV	OE – BME – 706	Home Medicare Technology	3	0	0	3
		OE – BME – 707	Design & Development of Medical Devices				
		OE – BME – 708	Bioinformatics & Expert System				
	Total Theory			**9**	**1**	**0**	**10**
Practical							
7	PC	PC – BME 791	Medical Image Processing & Analysis Lab	0	0	2	1
8	PROJ	PROJ – BME 792	Seminar on Industrial Visit	0	0	4	2
9	PROJ	PROJ – BME 793	Project I	0	0	12	6
	Total Practical			**0**	**0**	**18**	**9**
	Total of Third Semester			**9**	**1**	**18**	**19**

Fourth Year Eighth Semester

Sl. No.	Category	Subject Code	Subject Name	Total Number of contact hours			Credits
				L	T	P	
Theory							
1	Open Elective - V	OE – BME 801	Quality Control & Regulatory Aspects of Medical Devices	3	0	0	3
		OE – BME 802	TQM				
		OE – BME 803	Troubleshooting of Medical Instruments				
	Total Theory			**3**	**0**	**0**	**3**
Practical							
2	PROJ	PROJ – BME 891	Project II	0	0	12	6
	Total Practical			**0**	**0**	**12**	**6**
	Total of Fourth Semester			**3**	**0**	**12**	**9**

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Biomedical Engineering

(Applicable from the academic session 2018-2019)

SEMESTER-III

Subject Code : BS-M301	**Category:** Basic Science course
Subject Name : **Mathematics III**	**Semester** : Third
L-T-P : **3-1-0**	**Credit:4**
Pre-Requisites: No-prerequisite	

M#	Content	Hrs
1	**Laplace Transforms:** Concept of Periodic functions with graphs, Properties of Laplace Transform, Concept of Heaviside Unit-Step function, Convolution Theorem (Statement only), Laplace transform of elementary functions (emphasis on application of properties), Inverse Laplace transform, Application to the solution of ODE and PDE.	10
2	**Z-Transform:** Introduction to Z-Transform, Stability Criteria and Region of convergence, One sided and two sided Z-transform, Inverse Z-transform and application to solve difference equations, Applications of Z-transform, Idea of ROC and analysis of LTI Systems	8
3	**Fourier Transform:** Definition of Fourier Transformation, Concept of continuous Fourier transforms with properties, Properties of Fourier Transformation (proofs necessary), Fourier Transform of elementary functions (emphasis on application of properties), Fourier Sine and Cosine transforms, Convolution theorem and Parseval's Identity with application of Fourier Transformation, Statement of Fourier integral theorem, Inverse Fourier Transform, Idea of Applications of Fourier transform on periodic signals, Frequency response of LTI systems.	12
4	**Graph Theory:** Introduction to graph theory (Undirected graphs and Directed graphs), Walk; Path; Circuit, Euler graph, Hamiltonian graphs, Definition and properties of sub graph and dual graph, Shortest Path Algorithm: Dijkstra's Algorithm, Breadth First Search, Depth First Search algorithms, Matrix Representation of Graphs (Adjacency and Incidence), Isomorphic graphs, Tree; Properties of Tree; Root; Binary Tree, Spanning Tree: Prims & Krushkal algorithms.	10

COURSE OUTCOMES

At the end of the course, students should able to:

- Classify systems based on their properties and determine the response of LTI. **[Understanding Level 2]**
- Apply transform techniques for continuous-time function. **[Applying Level 3]**
- Analyze the systems using different transform techniques. **[Analyzing Level 4]**
- Interpret time domain and frequency domain representation of functions. **[Evaluating Level 5]**
- Solve engineering problems using transform techniques. **[Creating Level 6]**
- Apply principles and concepts of graph theory in practical fields. **[Applying Level 3]**

Text/Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
4. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008
5. N. Deo, Graph Theory, Prentice Hall of India, 1974.
6. James G.: Advanced Modern Engineering Mathematics, Pearson Education.
7. Kreyzig E.: Advanced Engineering Mathematics, John Wiley and Sons.
8. Ramana B.V.: Higher Engineering Mathematics, TMH.

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Biomedical Engineering

(Applicable from the academic session 2018-2019)

Subject Code : ES-EC301	**Category:** Engineering Science course
Subject Name : **Analog Electronic Circuits**	**Semester** : Third
L-T-P : **3-1-0**	**Credit:4**
Pre-Requisites: No-prerequisite	

M#	Content	Hrs
1	**Semiconductors and Signal Amplifiers:** Overview of semiconductors, PN junction diode-structure, operation and V-I characteristics, Rectifiers, Zener diode, BJT amplifiers: CE, CB and CC amplifiers, Gain and frequency response, designing of BJT amplifier networks, structure and characteristics of FET and MOSFET, CMOS basic principles.	10
2	**Filters and Regulators:** Capacitor filter, π-section filter, ripple factor, series and shunt voltage regulator, percentage regulation, 78xx and 79xx series, concept of SMPS.	4
3	**Operational Amplifiers and Applications:** Ideal OPAMP, Differential Amplifier, Constant current source, level shifter, CMRR, Open & Closed loop circuits, inverting & non-inverting amplifiers, voltage follower, adder, integrator & differentiator, comparator, Schmitt Trigger, V-I & I-V converter.	8
4	**Feedbacks and Oscillator Circuits:** Feedback Circuits: Concept of feedback, effect of negative feedback, feedback connection types, practical feedback circuits, designing of feedback amplifiers, Oscillators circuits: Oscillation principles, LC oscillators, RC oscillators, crystal oscillators, designing of oscillator circuits.	8
5	**Power Amplifiers and Tuned Amplifiers:** Class A, B, AB & C amplifiers, conversion efficiency, heat sink, designing of power amplifier circuits, tuned amplifier, synchronously tuned and impedance matching gain control.	6
6	**Waveform Generators and Switching Circuits:** Types of waveforms, transistor switching times, multivibrator, astable, monostable and bistable multivibrator, design of multivibrator.	4

COURSE OUTCOMES

At the end of the course, students should able to:

- Demonstrate working principle of different electronic circuit and their application in real life. **[Understanding Level 2]**
- Explain the operation and performance of semiconductor devices. **[Understanding Level 2]**
- Choose correct electronic devices to solve problems. **[Applying Level 3]**
- Analyse the effectiveness of electronic circuit used in day to day life. **[Analyzing Level 4]**
- Evaluate the feedback circuits and frequency response of amplifier. **[Evaluating Level 5]**
- Design and Conduct experiments using analog electronic circuits to function as switch, regulator, clippers, clampers, oscillators, power amplifiers.**[Creating Level 6]**

Text/ Reference Books:

1. Robert L. Boylestad, Louis Nashelsky, "Electronic Devices and Circuit Theory", Prentice Hall, Sixth edition, 2009.
2. Franco-Design with Operational Amplifiers & Analog Int. Circuits,3/e,McGraw Hill
3. Boylested & Nashelsky- Electronic Devices and Circuit Theory- Pearson/PHI
4. Millman & Halkias – Integrated Electronics, McGraw Hill.
5. Rashid-Microelectronic Circuits-Analysis and Design- Thomson (Cenage Learning)
6. Schilling & Belove—Electronic Circuit:Discrete & Integrated , 3/e , McGraw Hill
7. Razavi- Fundamentals of Microelectronic s- Wiley
8. Malvino—Electronic Principles , 6/e , McGraw Hill
9. Horowitz & Hill- The Art of Electronics; Cambridge University Press.
10. Bell- Operational Amplifiers and Linear ICs- Oxford UP
11. Tobey & Grame – Operational Amplifier: Design and Applications, Mc GrawHill.
12. Gayakwad R.A -- OpAmps and Linear IC's, PHI

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Biomedical Engineering

(Applicable from the academic session 2018-2019)

Subject Code : PC-BME301	**Category:** Professional Core course
Subject Name : **Anatomy & Physiology**	**Semester** : Third
L-T-P : **3-0-0**	**Credit:3**
Pre-Requisites: No-prerequisite	

M#	Content	Hrs
1	**Cell, Tissue and Blood:** Cell structure: Structure of cell and functions of sub organelles, cell membrane, membrane receptors, cell-to-cell signaling. Tissues: types of specialized tissues and functions. Blood: Components of blood and functions, blood groups and importance.	4
2	**Skeletal, Muscular and Lymphatic Systems:** Skeletal: Types of bone and function, anatomy of long bone, formation, growth and repair, types of joints and function. Muscular: Types of muscles, sliding filament theory, physiology of muscle contraction. Lymphatic: Parts and functions of lymphatic system, types of lymphatic organs and vessels.	6
3	**Cardiovascular and Respiratory Systems:** Cardiovascular: Structure of heart and role as pump, circulation types, heart valves, special junctional tissues, ECG, heart sounds, cardiac cycles, blood pressure, types of blood vessels, regulation of heart beat and blood pressure, diseases in cardiovascular systems. Respiratory: Parts of respiratory system, types of respiration, mechanism of breathing, respiratory membrane and gaseous exchange, regulation of respiration, volumes and capacities of lung, types of hypoxia.	10
4	**Digestive and Urinary Systems:** Digestive: Organs of digestive system, assessory organs of digestion and their functions, digestion and absorption. Urinary: Structure of kidney and nephron, mechanism of urine formation, micturition.	4
5	**Nervous & Endocrine Systems and Sense Organs:** Nervous: Structure and functions of neuron, synapse and impulse propagation, neuromuscular junction, brain, spinal cord, reflex mechanism, classification of nerves, autonomic nervous system and functions. Endocrine: Pituitary and thyroid glands. Sense Organs: Eye and ear.	6

COURSE OUTCOMES

At the end of the course, students should able to:

- Understand and relate structure function relationship of various physiological systems **[Understanding Level 2]**
- Explain interconnection of various systems and mechanism of communication and integration. **[Understanding Level 2]**
- Develop and apply critical reasoning skills in human physiology and anatomy **[Applying Level 3]**
- Analyze structural and functional aspects of living organisms. **[Analyzing Level 4]**
- Make measurements on and interpret data of physiological processes. **[Evaluating Level 5]**
- Build knowledge to aid diagnosis and for developing engineering systems. **[Creating Level 6]**

Text/ Reference Books:

1. Essential of Medical Physiology, Anil Baran Singha Mahapatra, Current Books International
2. Huamn Physiology - C.C.Chatterjee, Medical Allied Agency
3. Essential of Human Anatomy and Physiology, Elaine.N. Marieb Eight Edition, Pearson Education, New Delhi
4. Anatomy and Physiology – Ross & Wilson, Churchill Livigstone publications.
5. Modern Physiology & Anatomy for Nurses - J Gibson, Black-well Scientific Publishers
6. Medical Physiology, Guyton & Hall, 13th Edition, Elsevier Saunders
7. Concise Medical Physiology-bySujitK. Chaudhuri, 5th Edition, New Central Book Agency Pvt.Ltd.
8. Review of Medical Physiology, 22nd Edition, William F.Ganong, Mc Graw Hill, New Delhi

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Biomedical Engineering

(Applicable from the academic session 2018-2019)

Subject Code : PC-BME302	**Category:** Professional Core course
Subject Name : **Biophysics & Biochemistry**	**Semester** : Third
L-T-P : **3-0-0**	**Credit:3**
Pre-Requisites: No-prerequisite	

M#	Content	Hrs
1	**Biophysical Processes:** Diffusion, facilitated diffusion, active transport, phagocytosis and pinocytosis, absorption, reabsorption, osmosis, dialysis, ultrafiltration, ultracentrifugation, cellular fractionation, electrophoresis, plasmapherosis, radioimmunoassay.	3
2	**Biophysics of Membrane and Hemodynamics:** Molecular structure of cell membrane, membrane permeability and transport, Donnan membrane equilibrium, membrane potential, action potential, electrical properties of excitable membranes, capacitance, resistance, conductance and dielectric properties of membrane, equivalent electrical circuit for membrane, biophysical properties of plasma, viscosity of blood, rheological properties of blood, laminar blood flow, turbulent blood flow and Reynold's number, vascular resistance.	8
3	**Biophysical Activities:** Stimuli, receptor potential, strength-duration relationship, skin impedance, total body impedance, patient safety, electrical shock and hazards, leakage current, ECG, EEG, EMG, ERG and EOG wave forms.	4
4	**Introduction to Biochemistry:** Introduction: Chemical bonds, bio-fluids, electrolytes, weak acid and bases, pH, buffers, physiological buffers in living systems, Energy in living organism.	2
5	**Carbohydrates, Proteins & Enzymes:** Carbohydrates: Classification of carbohydrates, glycolysis, glycogenesis, TCA cycle, oxidative phosphorylation, biochemical aspects of Diabetes Mellitus and glycogen storage diseases. Lipids: Classification and functions of lipids, synthesis and degeneration of fatty acids, biosynthesis of cholesterol, disorders of lipid metabolism. Enzymes: Chemical nature and classification of enzymes, M-M-Kinetics, Isozymes and Allosteric enzymes, measurement of enzyme activity and isolation techniques.	8
6	**Nucleic Acids and Proteins:** Nucleic Acids: Structure of DNA, Genetic code, Recombinant DNA, structure of RNA and its types. Proteins: Structure and properties of proteins, classification of amino acids, Oxidative and non oxidative deamination, transamination, decarboxylation, urea cycle, separation of proteins.	5

COURSE OUTCOMES

At the end of the course, students should able to:

- Demonstrate the consequence of different biophysical and biochemical processes. **[Understanding Level 2]**
- Explain the biopotential and source of bio-signals. **[Understanding Level 2]**
- Make use of stimuli and experiments with biological signals. **[Applying Level 3]**

- Categorize the major biomolecules and infer their structure function relationships. **[Analyzing Level 4]**
- Evaluate the analytical techniques for biochemical measurements. **[Evaluating Level 5]**
- Proposed techniques for clinical applications. **[Creating Level 6]**

Text/ Reference Books:

1. Bio-Physics – Roland Glaser- Springer; 2nd printing edition (November 23, 2004)
2. The Biomedical Engineering Hand Book 3rd Ed (Biomedical Engineering Fundamentals)- Joseph D. Bronzino, CRC, Tylor Francis–2006 (Section-III–Bio-Electrical Phenomena)
3. Lehninger Principles of Biochemistry, Edition 5 - by David L. Nelson & Michael M.Cox , - W. H. Freeman; 2008.
4. Text book of Medical Physiology- Guyton
5. Jain, J L, Jain, Nitin, Sunjay Jain, "*Fundamentals of Biochemistry*," S. Chand Group, ISBN: 8121924537
6. Jeremy M. Berg, John L. Tymoczko, Lubert Stryer, "*Biochemistry*," Edition 7, W. H. Freeman, 2012
7. Fundamentals of Biochemistry: Life at the Molecular Level - by Donald J. Voet , Judith G. Voet & Charlotte W. Pratt. – Wiley
8. Robert Weaver, "*Molecular Biology*", MCGraw-Hill, 5th edition, 2012.
9. Outlines of Biochemistry,Conn, E.E; Stumpf, P.K; Bruening,G; Doi, R.H., John Wiley & Sons
10. Principles of Biochemistry (V Ed., By Nelson, D. L.; and Cox, M. M.W.H. Freeman & Co.
11. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
12. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Biomedical Engineering

(Applicable from the academic session 2018-2019)

Subject Code : PC-BME303	**Category:** Professional Core course
Subject Name : **Biosensors & Transducers**	**Semester** : Third
L-T-P : **3-0-0**	**Credit:3**
Pre-Requisites: No-prerequisite	

M#	Content	Hrs
1	**Introduction to Biological Sensors:** Sensors / receptors in the human body, basic organization of nervous system-neural mechanism, hot and cold receptors, barro receptors, sensors for smell, sound and vision.	2
2	**Biochemical Transducers:** Electrode theory: electrode-tissue interface, metal-electrolyte interface, electrode-skin interface, electrode impedance, Biopotential electrodes: microelectrodes, body surface electrodes, needle electrodes, electrodes for ECG, EEG, and EMG, Reference electrodes: hydrogen electrodes, silver-silver chloride electrodes, Calomel electrodes, Ion electrodes: specific ion electrodes, pH electrode, O2 electrode, CO2 electrode.	8
3	**Displacement, Pressure and Temperature Transducers:** Strain Gauge: Gauge factor, sensing elements, configuration, and unbounded strain gage. Capacitive transducer - various arrangements, Inductive transducer, LVDT, Passive types: RTD materials & range, resistance-temperature characteristics, thermistor characteristics, Active type: Thermocouple - characteristics.	10
4	**Photoelectric and Piezoelectric Transducers:** 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.	6
5	**Special Medical Applications of Sensors:** Gas sensor, Microbial sensor, electro analytical sensor, Enzyme based sensor-- Glucose sensor, Electronic nose-halitosis, Advances in sensor technology: Lab-on-a-chip, Smart sensor, MEMS and Nano sensor.	4

COURSE OUTCOMES

At the end of the course, students should able to:

- Classify sensors and transducers based on functions. **[Understanding Level 2]**
- Understand and explain the working principles of biosensors and transducers **[Understanding Level 2]**
- Select appropriate transducers for measurements of physical parameters. **[Applying Level 3]**
- Analyze various electrical parameters with accuracy and precision. **[Analyzing Level 4]**
- Measure physiological parameters and interpret the data. **[Evaluating Level 5]**
- Design and develop systems for tailor made applications. **[Creating Level 6]**

Text/ Reference Books:

1. R. S. Khandpur, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill.
2. S.C. Cobbold, “Transducers for Biomedical Instruments”, Prentice Hall.

3. Brown & Gann, "Engineering Principles in Physiology Vol. I", Academic Press.
4. Jon Cooper, "Biosensors A Practical Approach" Bellwether Books, 2004.
5. Carr & Brown, Introduction to Biomedical Equipment Technology Pearson Edn, Asia.
6. Rao & Guha,"Principles of Medical Electronics & Biomedical Instrumentation", University Press, India.
7. Iberall & Guyton, Regulation & Control in Physiological System, Instruments Soc.USA.
8. A.V.S. De Renck , "Touch Heat & Pain", Churchill Ltd. London.
9. Harry Thomas, "Handbook of Bio medical Instrumentation", Reston, Virginia.
10. D. L. Wise, "Applied Bio Sensors", Butterworth, London.

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Biomedical Engineering

(Applicable from the academic session 2018-2019)

Subject Code : HM-HU301	**Category:** Humanities and Social Sciences including Management courses
Subject Name : **Technical English**	**Semester** : Third
L-T-P : **2-0-0**	**Credit:2**
Pre-Requisites: No-prerequisite	

M#	Content	Hrs
1	**Technical Writing, Grammar and Editing:** Technical writing process, forms of discourse, Writing drafts and revising, Collaborative writing, creating indexes, technical writing style and language. Basics of grammar, study of advanced grammar, editing strategies to achieve appropriate technical style. Introduction to advanced technical communication, Usability, Hunan factors, Managing technical communication projects, time estimation, Single sourcing, Localization.	5
2	**Self-Development and Assessment:** Self-assessment, Awareness, Perception and Attitudes, Values and belief, Personal goal setting, career planning, Self-esteem. Managing Time; Personal memory, Rapid reading, Taking notes; Complex problem solving; Creativity.	5
3	**Communication and Technical Writing:** Public speaking, Group discussion, Oral; presentation, Interviews, Graphic presentation, Presentation aids, Personality Development. Writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes, business letters, memos, progress reports, minutes of meetings, event report.	5

COURSE OUTCOMES

At the end of the course, students should able to:

- Demonstrate the ability to read and comprehend engineering and technology texts. **[Understanding Level 2]**
- Develop speaking skills to make technical presentation and participate in group discussion. **[Applying Level 3]**
- Express and exchange ideas effectively through various modes of communication. **[Applying Level 3]**
- Analyze content to identify main and subordinate ideas, distinguish various modes of argument and outline methods of development. **[Analyzing Level 4]**
- Evaluate technical reports and judge its authenticity. **[Evaluating Level 5]**
- Formulate strategies for persuasive arguments and tools for success. **[Creating Level 6]**

Text/Reference Books:

1. David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York, 2004
2. Diane Hacker, Pocket Style Manual, Bedford Publication, New York, 2003. (ISBN 0312406843)
3. Shiv Khera, You Can Win, Macmillan Books, New York, 2003.
4. Raman Sharma, Technical Communications, Oxford Publication, London, 2004.

5. Dale Jungk, Applied Writing for Technicians, McGraw Hill, New York, 2004. (ISBN: 07828357-4)
6. Sharma, R. and Mohan, K. Business Correspondence and Report Writing, TMH New Delhi 2002.
7. Xebec, Presentation Book, TMH New Delhi, 2000. (ISBN 0402213)

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Biomedical Engineering

(Applicable from the academic session 2018-2019)

PRACTICAL

Subject Code : HM-HU391	**Category:** Humanities and Social Sciences including Management courses
Subject Name : **INTERPERSONAL SKILL & REPORT WRITING [SESSIONAL]**	**Semester** : Third
L-T-P : **0-0-2**	**Credit:1**
Pre-Requisites: No-prerequisite	

Subject Code : ES-EC391	**Category:** Engineering Science course
Subject Name : **Analog Electronic Circuits Lab**	**Semester** : Third
L-T-P : **0-0-2**	**Credit:1**
Pre-Requisites: No-prerequisite	

LIST OF EXPERIMENTS:

1. Study of Diode as clipper & clamper.
2. Study of Zener diode as a voltage regulator.
3. Study of ripple and regulation characteristics of full wave rectifier without and with capacitor filter.
4. Study of characteristics curves of BJT & FET.
5. Construction of R-C coupled amplifier & study the gain and Bandwidth.
6. Study of class A & class B power amplifiers.
7. Study of class C & Push-Pull amplifiers.
8. Realization of current mirror & level shifter circuit using Operational Amplifiers.
9. Construction & study of astable multivibrator using NE 555.
10. Construction & study of monostable & Bistable multivibrator using NE 555.

COURSE OUTCOMES

At the end of the course, students should able to:

- Choose electronic components for construction of basic circuits for specific purposes. **[Applying Level 3]**
- Conduct experiments and verify the results / outputs practically. **[Analyzing Level 4]**
- Assess and recommend an application device of their interest. **[Evaluating Level 5]**
- Design and test fundamental analog electronic circuits. **[Creating Level 6]**

Subject Code : PC-BME391	**Category:** Professional Core course
Subject Name : **PHYSIOLOGY & BIOCHEMISTRY LABORATORY**	**Semester** : Third
L-T-P : **0-0-2**	**Credit:1**
Pre-Requisites: No-prerequisite	

LIST OF EXPERIMENTS:

1. Identification and enumeration of various histological slides
2. Measurement of total count for RBC & WBC & differential count for WBC.
3. Determination of ESR, BT, CT
4. Determination of Blood Group (ABO; Rh).
5. Estimation of Hemoglobin
6. Determination of blood pressure
7. Measurement of pH, and conductivity of body fluid.
8. Measurement of viscosity of Blood
9. Recording and analysis of ECG, EMG, EEG
10. Quantitative estimation of blood glucose, protein

COURSE OUTCOMES

At the end of the course, students should able to:

- Identify and select appropriate tools for measurement of physiological and biochemical parameters. **[Applying Level 3]**
- Conduct experiments and analyze the outputs practically. **[Analyzing Level 4]**
- Evaluate the compatibility for any clinical measurements. **[Evaluating Level 5]**
- Propose analytical methods and plan for quantitative measurement. **[Creating Level 6]**

Subject Code : PC-BME392	**Category:** Professional Core course
Subject Name : **BIOSRNSORS & TRANSDUCERS LABORATORY**	**Semester** : Third
L-T-P : **0-0-2**	**Credit:1**
Pre-Requisites: No-prerequisite	

LIST OF EXPERIMENTS:

1. Characteristics of temperature sensors: RTD, Thermocouple, P-N junction diode transistor.
2. Measurement of displacement: Capacitive transducer, LVDT
3. Characteristics of light sensors: LDR, Photodiode, Phototransistor
4. Study of load cell with tensile and compressive load
5. Measurement of torque using strain gauge transducer
6. Study of proximity detector: ultrasonic, IR
7. Measurement of respiration rate: Thermistor, Piezoelectric sensors.
8. Study of the characteristics of level sensor for saline IV set.
9. Study & characterization of Biotransducers: Pressure, Temparature, Humidity
10. Study & characterization of Bioelectrodes: ECG, EMG, EEG

COURSE OUTCOMES

At the end of the course, students should able to:

- Select proper sensors and transducers for measurement of biophysical phenomenon. **[Applying Level 3]**
- Conduct experiments and analyze the result practically **[Analyzing Level 4]**
- Evaluate and compare the measure data for clinical representation. **[Evaluating Level 5]**
- Design and test system for detection of physiological signals. **[Creating Level 6]**