Syllabus for B.Tech(Biomedical Engineering) Second Year

Revised & Proposed Syllabus of B.Tech in BME (To be followed from the academic session, July 2011, i.e. for the students who were admitted in Academic Session 2010-2011)

BME SECOND YEAR: THIRD SEMESTER

Sl.No.	Field	Theory	Contact Hours/Week				Cr. Pts
			L	T	P	Total	
		A. THEORY					
1	M(CS)301	Numerical Methods	2	0	2	2	2
2	M302	Mathematics-III	3	1	0	4	4
3	BME301	Biophysical Signals & Systems	3	0	0	3	3
4	BME(EC)301	Circuit Theory & Networks	3	0	0	3	3
5	BME302	Engineering Physiology & Anatomy	3	1	0	4	4
6	BME(EC)304	Analog Electronic Circuits	3	1	0	4	4
		Total of Theory				**20**	**20**
		B. PRACTICAL					
7	M(CS)391	Numerical methods Lab	0	0	2	2	1
8	BME391	Biophysical Signals & Systems Lab	0	0	3	3	2
9	BME(EC)391	Circuits & Networks Lab	0	0	3	3	2
10	BME392	Physiology Lab	0	0	3	3	2
11	BME(EC)394	Analog Electronic Circuits Lab	0	0	3	3	2
		Total of Practical				**14**	**9**
		Total of Semester				**34**	**29**

BME SECOND YEAR: FOURTH SEMESTER

Sl.No.	Field	Theory	Contact Hours/Week				Cr. Pts
			L	T	P	Total	
		A. THEORY					
1	HU401	Values & Ethics in Profession	3	0	0	3	3
2	BME(PH)401	Biophysics & Biochemistry	3	1	0	4	4
3	CH401	Basic Environmental Engineering & Elementary Biology	2 1	0	0	2 1	3
4	BME402	Biosensors & Transducers	3	1	0	4	4
5	BME(EC)402	Digital Electronics & Integrated Circuits	3	1	0	4	4
		Total of Theory				**18**	**18**
		B. PRACTICAL					
6	HU481	Communication skill & Report writing	0	0	3	3	2
7	BME491	Biophysics & Biochemistry Lab	0	0	3	3	2
8	BME492	Biosensors & Transducers Lab	0	0	3	3	2
9	BME(EC)492	Digital Electronics & Integrated Circuits Lab	0	0	3	3	2
		Total of Practical				**12**	**8**
		Total of Semester				**30**	**26**

Syllabus for B.Tech (BME) Second Year

SEMESTER – III

THEORY

NUMERICAL METHODS

Code: M (CS) 301 **Contacts: 2L** **Credits: 2**

Approximation in numerical computation: Truncation and rounding errors, Fixed and floating-point arithmetic, Propagation of errors. (4)

Interpolation: Newton forward & backward interpolation, Lagrange's and Newton's divided difference Interpolation. (5)

Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Weddle's rule. (3)

Numerical solution of a system of linear equations:
Gauss elimination method, Matrix inversion, LU Factorization method, Gauss-Jacobi and Gauss-Seidel iterative methods.
(6)

Numerical solution of Algebraic equation:
Bisection method, Secant method, Regula-Falsi method, Newton-Raphson method. (4)

Numerical solution of ordinary differential equation: Taylor's series method, Euler's method, Runge-Kutta methods, Predictor-Corrector methods and Finite Difference method. (6)

Text Books:

1. C.Xavier: C Language and Numerical Methods.
2. Dutta & Jana: Introductory Numerical Analysis.
3. J.B.Scarborough: Numerical Mathematical Analysis.
4. Jain, Iyengar , & Jain: Numerical Methods (Problems and Solution).

References:

1. Balagurusamy: Numerical Methods, Scitech.
2. Baburam: Numerical Methods, Pearson Education.
3. N. Dutta: Computer Programming & Numerical Analysis, Universities Press.
4. Soumen Guha & Rajesh Srivastava: Numerical Methods, OUP.
5. Srimanta Pal: Numerical Methods, OUP.

MATHEMATICS-III

Code: M 302 **Contacts: 3L +1T** **Credits: 4**

Note 1: The whole syllabus has been divided into five modules.

Note 2: Structure of the question paper

There will be three groups in the question paper. In Group A, there will be one set of multiple choice type questions spreading the entire syllabus from which 10 questions (each carrying one mark) are to be answered. From Group B, three questions (each carrying 5 marks) are to be answered out of a set of questions covering all the three modules. Three questions (each carrying 15 marks) are to be answered from Group C. Each question of Group C will have

two or three parts covering not more than two modules. Sufficient questions should to be set covering the whole syllabus for alternatives.

Module I

Fourier Series:

Introduction, Periodic functions, Even and odd functions, Special waveforms, Eulers formulae for Fouriers coefficients, Dirichlet's conditions and sum of the Fourier series, Half range Fourier series, Parseval's identity (Statement only).

Fourier Transform: Fourier Transform and its properties, Inverse Fourier Transform (Statement only), Fourier Transform of derivatives (Statement only), Convolution theorem (Statement only). Related problems. (8L)

Module II

Calculus of Complex variable:

Functions, Limit and Continuity, Analytic functions, Cauchy-Riemann equations

(Statement only) and related problems, Analytic continuation, Complex integration and Cauchy's theorem (Statement only), Cauchy's integral formula (Statement only), Taylors and Laurent series, Zeros of an analytic function, Poles, Essential singularities, Residue theorem (Statement only) and its application to evaluation of definite integrals (Elementary cases only), Introduction to Conformal Mapping. (12L)

Module III

Probability:

Axiomatic definition of probability, Conditional probability, Independent events, Related problems, Bayes theorem (Statement only) & its application. One dimensional random variable, Probability distributions-discrete and continuous, Expectation, Binomial, Poisson, Uniform, Exponential and Normal distribution, Problems on Binomial, Poisson and Normal distribution only. (12L)

Module IV

Partial Differential Equations:

Solution of one dimensional wave equation, One dimensional heat-conduction equation, Laplace equation in two dimension by the methods of

1: Separation of variables 2: Integral Transforms (Laplace and Fourier Transforms)

(6L)

Module V

Series solution of Ordinary Differential equation:

Introduction, validity of series solution of an ordinary differential equation, general method to solve equation of the type: $P_o y'' + P_1 y' + P_2 y = 0$, related problems, Bessel's equation, properties of Bessel's function, Recurrence formula for Bessel's function of first kind, Legendre's equation, Legendre function; Recurrence formula for Legendre function ($P_n(x)$); Orthogonality relation. (10L)

Text Books:

1. Brown J.W and Churchill R.V: Complex Variables and Applications, McGraw-Hill.
2. Das N.G.: Statistical Methods, TMH.
3. Grewal B S: Higher Engineering Mathematics, Khanna Publishers.
4. James G.: Advanced Modern Engineering Mathematics, Pearson Education.
5. Lipschutz S., and Lipson M.L.: Probability (Schaum's Outline Series), TMH.

References:

1. Bhamra K. S.: Partial Differential Equations: An introductory treatment with applications, PHI
2. Dutta Debashis: Textbook of Engineering Mathematics, New Age International Publishers.
3. Kreyzig E.: Advanced Engineering Mathematics, John Wiley and Sons.
4. Potter M.C, Goldberg J.L and Aboufadel E.F.: Advanced Engineering Mathematics, OUP.
5. Ramana B.V.: Higher Engineering Mathematics, TMH.

BIOPHYSICAL SIGNALS AND SYSTEMS

Code: BME 301 **Contacts: 3L** **Credits: 3**

M#	Content	Hrs
1	**Signals and systems:** Continuous time (CT) signals, Discrete time (DT) signals, periodic, aperiodic, random, energy and power signals, step, ramp, impulse and exponential function, Transformation in independent variable of signals: time scaling, time shifting and time inverting, classification and properties of systems, LTI systems - convolution and stability, physiological signals and their properties, Time invariant and time varying physiological systems.	6
2	**Signal analysis**: Basic concepts and development of the Fourier Series, Determination of the Fourier series representation of Continuous and Discrete time periodic signal, Properties of continuous and discrete time Fourier series, Continuous Time Fourier Transform (CTFT) and Discrete Time Fourier Transform (DTFT), ECG signal analysis.	6
3	**Sampling Theorem and Z-Transforms**: Representation of continuous time signals by its sample, Sampling theorem, Reconstruction of a Signal from its samples, aliasing, Basic principles of z-transform, z-transform definition, Properties of z-transform, Poles and Zeros, inverse z-transform.	6
4	**Noise and Feed Back System:**: Sources and types of noise, noise factor and temperature, equivalent noise resistance and noise factor in cascade amplifier, Basic Feedback concept, Positive and Negative Feedback, Sensitivity analysis, Effect of Feedback on disturbance or Noise, Distortion analysis by Feed Back, Control system, Open loop Control System, Control system With Feed Back, Application of feed back in physiological systems and its importance.	8
5	**Filtering Techniques:** Types of filter (Active and Passive), General idea of L.P.F, H.P.F, B.P.F and N.F. First order Passive Filters (L.P, H.P, B.P & N.F), First order active filter (L.P, H.P, B.P & N.F), use of filter for biomedical signal analysis, design of filter suitable for Bio-medical signal analysis.	4

6	**Physiological System**: Block diagram representation of cardio vascular system, Electrical circuit model of Blood Pressure, Electrical analog of blood vessels and its transfer function, model of coronary circulation ant its analysis, Germ, Plasma cell, Antibody, system equation and transfer function. Application of feedback and block diagram reduction techniques.	4

Reference Books:

1. Oppenheim, Wilskey and Nawab-Signal & System, Prentice Hall India.
2. Hayken & Van Veen- Signal & System,Willey
3. Taub & Schilling-Principles of Communication System, Tata McGraw Hill.
4. Kennedy & Devis-Electronic Communication System, Tata McGraw Hill
5. Gayakward-Opamps and Linear Integrated Circuits , Prentice Hall India
6. A.K.Sawhney-Electrical & Electronic Measurement & Instrumentation, Dhanpat Rai & Co. (P) Ltd.

CIRCUIT THEORY & NETWORKS

Code: BME (EC) 301 **Contacts: 3L** **Credits: 3**

M#	Content	Hrs
1	**Resonant Circuits**: Series and Parallel Resonance, Impedance and Admittance Characteristics, Quality Factor, Half-Power Points, Bandwidth, Resonant voltage rise, Transform diagrams, Solution of Problems	4
2	**Mesh Current Network Analysis**: Kirchoff's Voltage Law, Formulation of Mesh Equations, Solution of mesh equations by Cramer's rule and matrix method, Driving point impedance, Transfer impedance, Solutions of Problems with DC and AC sources	6
3	**Node Voltage Network Analysis**: Kirchoff's Current Law, Formulation of node equations and solutions, Driving point admittance, Transfer admittance, Solutions of Problems with DC and AC sources	4
4	**Network Theorems**: Definition and implications of Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Compensation Theorem, Maximum Power Transfer Theorem, Millman's Theorem, Star-Delta transformations, Solutions and Problems with DC and AC sources	6
5	**Graph of Network**: Concept of Tree Branch, Tree link, junctions, Incident matrix, Tie-set matrix, Cut-set matrix, determination of loop current and node voltages.	4
6	**Coupled Circuits**: Magnetic Coupling, polarity of coils, polarity of induced voltage, concept of self and mutual inductance, coefficient of coupling, Solution of Problems	2
7	**Circuit Transients**: DC Transient in R-L & R-C circuits with and without initial charge, R-L-C circuits, AC transients in sinusoidal R-L, R-C, & R-L-C circuits, solution of problems	4
8	**Laplace Transform**: Concept of complex frequency, transformation of f(t) into F(s), transformation of step, exponential, overdamped surge, critically damped surge, damped sine, undamped sine functions, properties of Laplace Transform, linearity, real-differentiation, realintegration, Initial Value Theorem and Final Value Theorem, Inverse Laplace Transform, applications in circuit analysis, Partial Fractions expansion, Heaviside's Expansion Theorem, solution of problems	8
9	**SPICE**: Introduction, model statement, elementary DC and small-signal analysis.	2

Text Books:

1. Valkenburg M. E. Van, Network Analysis, Prentice Hall./Pearson Education
2. Hayt"Engg Circuit Analysis 6/e Tata McGraw-Hill
3. D.A.Bell- Electrical Circuits- Oxford

References:

1. A.B.Carlson-Circuits- Cenage Learning
2. John Bird- Electrical Circuit Theory and Technology- 3/e- Elsevier (Indian Reprint)
3. Skilling H.H.: "Electrical Engineering Circuits", John Wiley & Sons.
4. Edminister J.A.: "Theory & Problems of Electric Circuits", McGraw-Hill Co.
5. Kuo F. F., "Network Analysis & Synthesis", John Wiley & Sons.
6. R.A.DeCarlo & P.M.Lin- Linear Circuit Analysis- Oxford
7. P.Ramesh Babu- Electrical Circuit Analysis- Scitech

8. Sudhakar: "Circuits & Networks:Analysis & Synthesis" 2/e TMH
9. M.S.Sukhija & T.K.NagSarkar- Circuits and Networks-Oxford
10. Sivandam- "Electric Circuits and Analysis", Vikas
11. V.K. Chandna, "A Text Book of Network Theory & Circuit Analysis",Cyber Tech
12. Reza F. M. and Seely S., "Modern Network Analysis", Mc.Graw Hill .
13. M. H. Rashid:Introduction to PSpice using OrCAD for circuits and electronics, Pearson
14. Roy Choudhury D., "Networks and Systems", New Age International Publishers.
15. D.Chattopadhyay and P.C.Rakshit: "Electrical Circuits" New Age

ENGINEERING PHYSIOLOGY & ANATOMY

Code: BME 302 **Contacts: 3L +1L** **Credits: 4**

M#	Content	Hrs
1	**Cell:** Cell membrane and organelles, Ion channels, Receptors and carriers, Intercellular communication, Membrane potential, Action Potential, Generation and Conduction, Blood Cells, Origin of RBC, structure and function of haemoglobin, Plasma proteins, Bone marrow, Hematocrit, ESR and its significance, Blood volume regulation, blood coagulation and factors, Bleeding and clotting time, immunity and antibodies, Blood Groups and blood transfusion.	8
2	**Muscular & Nervous System:** Type of muscles and functional differences, Electron microscopic structure of skeletal muscle, Salient properties of muscles (excitability and contractility, all or none law, refractory period, fatigue and elasticity), Muscles as energy transducer, Muscle contraction (E-C coupling mechanism), Structure and function of neurons, Electrical potentials (Generator & receptor), Nerve conduction, synapse and properties, synaptic transmission, neurotransmitters, motor unit, Neuromuscular junction, receptors and reflex arc, Brain, spinal cord.	8
3	**Cardiac & Respiratory System:** Structure of heart and role as pump, Major blood vessels, ultra structure of blood vessels, Heart valves, Special junctional tissues of heart, heart sounds, Cardiac cycle, Cardiac output, Coronary and peripheral circulation, Nerve control of heart, Blood Pressure, Feedback Control for Blood Pressure, Respiratory pathways (upper and lower), Mechanism of respiration, respiratory membrane and gaseous exchange, feedback control mechanism of respiration.	10
4	**Digestive & Excretory System:** Organisation of GI System, Digestion and absorption, Movements of GI tract, Intestine, Liver, Pancreas, Structure of Nephron, Mechanism of Urine formation, Urine Reflex, Skin and Sweat Gland, Temperature regulation.	6
5	**Eye, Ear & Endocrine Glands:** Optics of Eye, Retina, Photochemistry of Vision, Neuro-physiology of vision, Accommodation, Physiology of middle and internal ear, Auditory Pathway, Mechanism of Hearing, Endocrine glands.	4
6	**Skeletal System & Joints:** Types of bones, classification, Structure and composition of bone, mechanical and electrical properties of bone, blood supply, Cartilage, tendon, ligament, Classification of joints, structure of synovial joint, major joints of the limbs and Temporomandibular joint.	4

Reference Books:

1. Essential of Medical Physiology - Anil Baran Singha Mahapatra, Current Books International
2. Human Physiology - C.C.Chatterjee, Medical Allied Agency
3. Text book of Medical Physiology- Guyton
4. Concise Medical Physiology - Chauduri
5. Anatomy and Physiology – Ross & Wilson, Churchill Livigstone publications.
6. Modern Physiology & Anatomy for Nurses - J Gibson, Black-well Scientific Publishers

ANALOG ELECTRONIC CIRCUITS

Code: BME (EC) 304 **Contacts: 3L +1L** **Credits: 4**

M#	Content	Hrs
1	**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
2	**Transistor Biasing and Stability**: Q-point, Self Bias-CE, Compensation techniques, h-model of transistors. Expression for voltage gain, current gain, input and output impedance, trans-resistance & trans-conductance; Emitter follower circuits, High frequency model of transistors.	6
3	**Transistor Amplifiers**: RC coupled amplifier, functions of all components, equivalent circuit, derivation of voltage gain, current gain, input impedance and output impedance, frequency response characteristics, lower and upper half frequencies, bandwidth, and concept of wide band amplifier.	6
4	**Feedback Amplifiers & Oscillators**: Feedback concept, negative & positive feedback, voltage/ current, series/shunt feedback, Berkhausen criterion, Colpitts, Hartley's, Phase shift, Wein bridge and crystal oscillators.	4
5	**Operational Amplifier**: Ideal OPAMP, Differential Amplifier, Constant current source (current mirror etc.), level shifter, CMRR, Open & Closed loop circuits, importance of feedback loop (positive & negative), inverting & non-inverting amplifiers, voltage follower/buffer circuit.	6
6	**Applications of Operational Amplifiers**: adder, integrator & differentiator, comparator, Schmitt Trigger. Instrumentation Amplifier, Log & Anti-log amplifiers, Trans-conductance multiplier, Precision Rectifier, voltage to current and current to voltage converter, free running oscillator.	6
7	**Power amplifiers** – Class A, B, AB, C, Conversion efficiency, Tuned amplifier	4
8	**Multivibrator:**Monostable, Bistable,Astable multivibrators; Monostable and astable operation using 555 timer.	2
9	**Special Functional Circuits**: VCO and PLL.	2

Text Books:

1. Sedra & Smith-Microelectronic Circuits- Oxford UP
2. Franco—Design with Operational Amplifiers & Analog Integrated Circuits,3/e,McGraw Hill
3. Boylested & Nashelsky- Electronic Devices and Circuit Theory- Pearson/PHI

References:

1. Millman & Halkias – Integrated El;ectronics, McGraw Hill.
2. Rashid-Microelectronic Circuits-Analysis and Design- Thomson (Cenage Learning)
3. Schilling & Belove—Electronic Circuit:Discrete & Integrated , 3/e , McGraw Hill
4. Razavi- Fundamentals of Microelectronic s- Wiley
5. Malvino—Electronic Principles , 6/e , McGraw Hill
6. Horowitz & Hill- The Art of Electronics; Cambridge University Press.
7. Bell- Operational Amplifiers and Linear ICs- Oxford UP
8. Tobey & Grame – Operational Amplifier: Design and Applications, Mc GrawHill.
9. Gayakwad R.A -- OpAmps and Linear IC's, PHI
10. Coughlin and Driscol–Operational Amplifier and Linear Integrated Circuits–Pearson Edn

PRACTICAL

NUMERICAL METHODS LABORATORY
Code : M(CS) 391 Contacts: 2P Credits :1

1. Assignments on Newton forward & backward, Lagrange's interpolation.
2. Assignments on numerical integration using Trapezoidal rule, Simpson's 1/3 rule, Weddle's rule.
3. Assignments on numerical solution of a system of linear equations using Gauss elimination, Matrix inversion, Gauss-Jacobi, and Gauss-Seidel iterations.
4. Assignments on numerical solution of Algebraic Equation by Bisection, Secant, Regular-falsi and Newton Raphson methods.
5. Assignments on ordinary differential equation: Taylor series, Euler's, Runga-Kutta and Finite difference methods.
6. Introduction to Software Packages: Matlab / Scilab / Labview / Mathematica.

BIOPHYSICAL SIGNALS & SYSTEMS LABORATORY
Code : BME 391 Contacts: 3P Credits :2

The following simulation exercise should be carried out in MATLAB or C programming.

1. Familiarization with MATLAB and generation of various types of waveforms (sine, cosine, square, triangular etc.).
2. Generation of different functions (unit impulse, unit step, RAMP, etc.)
3. Find out the signal energy and power
4. Generation of various types of noise (uniform white, Gaussian, coloured etc.).
5. Analysis CTFT & DTFT
6. To study Z- transform of: a) Sinusoidal signals b) Step functions.
7. To study LPF &HPF, band pass and reject filters using RC circuits
8. ECG signal analysis / Equivalent electrical circuit analysis of blood vessels

CIRCUITS & NETWORKS LABORATORY
Code : BME(EC) 391 Contacts: 3P Credits :2

1. Characteristics of Series & Parallel Resonant circuits
2. Verification of Network Theorems
3. Transient Response in R-L & R-C Networks ; simulation / hardware
4. Transient Response in RLC Series & Parallel Circuits & Networks; simulation / hardware
5. Determination of Impedance (Z), and Admittance (Y) parameters of Two-port networks
6. Generation of periodic, exponential, sinusoidal, damped sinusoidal, step, impulse, and ramp signals using MATLAB
7. Representation of Poles and Zeros in s-plane, determination of partial fraction expansion in s-domain and cascade connection of second-order systems using MATLAB
8. Determination of Laplace Transform, different time domain functions, and Inverse Laplace Transformation using MATLAB

Note: An Institution / college may opt for some other hardware or software simulation wherever possible in place of MATLAB

PHYSIOLOGY LABORATORY
Code : BME 392 **Contacts: 3P** **Credits :2**

1. Identification of histological slides – nerve tissues (cerebellum, cerebral cortex, neurons, spinal cord, nodes of Ranvier, corneal cell space), renal tissues. Blood vessels (artery & vein), skin, tongue, liver.
2. Blood film making & identification of different blood corpuscles.
3. Measurement of TC of RBC & WBC & DC of WBC.
4. Determination of ESR
5. Determination of BT, CT
6. Determination of Blood Group (ABO; Rh).
7. Hemoglobin estimation
8. Determination of blood pressure

ANALOG ELECTRONIC CIRCUITS LABORATORY
Code : BME(EC) 394 **Contacts: 3P** **Credits :2**

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 B.J.T & F.E.T .
5. Construction of a two-stage R-C coupled amplifier & study of it's gain & 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. Study of timer circuit using NE555 & configuration for monostable & astable multivibrator.
10. Construction & study of Bistable multivibrator using NE 555.
11. Study of Switched Mode Power Supply & construction of a linear voltage regulator using regulator IC chip.
12. Construction of a simple function generator using IC.
13. Realization of a V-to-I & I-to-V converter using Op-Amps.
14. Realization of a Phase Locked Loop using Voltage Controlled Oscillator (VCO).
15. Study of D.A.C & A.D.C.

SEMESTER – IV

THEORY

VALUES & ETHICS IN PROFESSION

Code: HU 401 **Contacts: 3L** **Credits: 3**

Science, Technology and Engineering as knowledge and as Social and Professional Activities

Effects of Technological Growth:

Rapid Technological growth and depletion of resources, Reports of the Club of Rome. Limits of growth: sustainable development
Energy Crisis: Renewable Energy Resources
Environmental degradation and pollution. Eco-friendly Technologies. Environmental Regulations, Environmental Ethics
Appropriate Technology Movement of Schumacher; later developments
Technology and developing notions. Problems of Technology transfer, Technology assessment impact analysis.
Human Operator in Engineering projects and industries. Problems of man, machine, interaction, Impact of assembly line and automation. Human centered Technology.

Ethics of Profession:

Engineering profession: Ethical issues in Engineering practice, Conflicts between business demands and professional ideals. Social and ethical responsibilities of Technologists. Codes of professional ethics. Whistle blowing and beyond, Case studies.

Profession and Human Values:

Values Crisis in contemporary society
Nature of values: Value Spectrum of a good life
Psychological values: Integrated personality; mental health
Societal values: The modern search for a good society, justice, democracy, secularism, rule of law, values in Indian Constitution.
Aesthetic values: Perception and enjoyment of beauty, simplicity, clarity
Moral and ethical values: Nature of moral judgements; canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility.

Books:

1. Stephen H Unger, Controlling Technology: Ethics and the Responsible Engineers, John Wiley & Sons, New York 1994 (2nd Ed)
2. Deborah Johnson, Ethical Issues in Engineering, Prentice Hall, Englewood Cliffs, New Jersey 1991.
3. A N Tripathi, Human values in the Engineering Profession, Monograph published by IIM, Calcutta 1996.

BIOPHYSICS & BIOCHEMISTRY

Code: BME(PH) 401 **Contacts: 3L+1T** **Credits: 4**

M#	Content	Hrs
1	**Biological principles:** Composition & properties of the cell membrane, membrane transports, permeability Coefficient & partition coefficient, body fluids, electrolytes, acid-base balance, blood viscosity and Newtonian nature, colloids, filtration, diffusion, osmosis, dialysis, ultrafiltration, ultracentrifugation, cellular fractionation, electrophoresis, plasmapherosis, radioimmunoassay, Photochemical reaction, law of photochemistry, fluorescence and phosphorescence.	8
2	**Bioelectricity:** Membrane Potential, Local and propagator types, Diffusion potential, phase boundary potentials, Generator Potentials, compound Action Potentials (AP), Propagation of AP, factors influencing propagation of AP, biosignal and types, Electrical properties of excitable membranes, Membrane Capacitance, Resistance, conductance, dielectric properties of membrane, space and time constant for excitable membrane, equivalent electrical circuit diagram for excitable membranes and neural membranes.	8
3	**Electrical stimulus & Biophysical activity:** Stimuli, Receptor potential, pacemaker potential, strength-duration relationship, skin impedance, total body impedance, impedances at high frequencies, patient safety, electrical shock and hazards, leakage current, Electrical activity of brain (EEG), different wave forms & their characteristics, Electrical activity of heart (ECG), waveform and significance, Electrical activity of muscles (EMG) and muscle tone, Electro-RetinoGram(ERG), Electro-Occologram (EOG)	8
4	**Radioactivity:** Ionizing radiations, U-V & I-R radiations, Production of radioisotopes & their use in biomedical research, Radioactive decays, Half life period, Linear Energy Transfers (LET), Relative Biological Efficiency (RBE) and Interaction of radiation with-matter	4
5	**Macromolecules:** Classification and functions of carbohydrates, glycolysis, TCA cycle, ATP sysnthesis, Blood Sugar analysis and glucose tolerance test, Classification and functions of proteins, architecture of proteins, Classification of amino acids, Oxidative and non oxidative deamination, transamination, decarboxylation, urea cycle, **Purification/separation** of proteins, Classification and functions of lipids, biosynthesis of long chain fatty acids, oxidation and degradation of fatty acids.	8
6	**Enzymes and Nucleic acids:** Chemical nature and broad classification of enzymes, M-M-Kinetics, Isozymes and Allosteric enzymes, Isolation techniques, Structure of DNA, Genetic code, Recombinant DNA, Transcription & Translation, Reverse Transcription, Replication.	4

Reference Books:

1. Radiation Biophysics, Second Edition - by Edward L. Alpen - Academic Press; 2 edition
2. Bio-Physics – Roland Glaser- Springer; 2nd printing edition (November 23, 2004)
3. Text book of Medical Physiology- Guyton
4. The Biomedical Engineering Hand Book- 3rd Ed- (Biomedical Engineering Fundamentals) - Joseph D. Bronzino – CRC –Tylor-Francis – 2006 (Section- III – Bio-Electrical Phenomena)
5. Lehninger Principles of Biochemistry, Fourth Edition - by David L. Nelson & Michael M.Cox , - W. H. Freeman; 4 edition (April 23, 2004)
6. Fundamentals of Biochemistry: Life at the Molecular Level - by Donald J. Voet , Judith G. Voet & Charlotte W. Pratt. - Wiley; 2 edition (March 31, 2005)

BASIC ENVIORNMENTAL ENGINEERING & ELEMENTARY BIOLOGY

Code: CH 401 **Contacts: 3L** **Credits: 3**

General

Basic ideas of environment, basic concepts, man, society & environment, their interrelationship.

1L

Mathematics of population growth and associated problems, Importance of population study in environmental engineering, definition of resource, types of resource, renewable, non-renewable, potentially renewable, effect of excessive use vis-à-vis population growth, Sustainable Development.

2L

Materials balance: Steady state conservation system, steady state system with non conservative pollutants, step function. 1L

Environmental degradation: Natural environmental Hazards like Flood, earthquake, Landslide-causes, effects and control/management; Anthropogenic degradation like Acid rain-cause, effects and control. Nature and scope of Environmental Science and Engineering.

2L

Ecology

Elements of ecology: System, open system, closed system, definition of ecology, species, population, community, definition of ecosystem- components types and function. 1L

Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (special reference to Sundar ban); Food chain [definition and one example of each food chain], Food web. 2L

Biogeochemical Cycle- definition, significance, flow chart of different cycles with only elementary reaction [Oxygen, carbon, Nitrogen, Phosphate, Sulphur]. 1L

Biodiversity- types, importance, Endemic species, Biodiversity Hot-spot, Threats to biodiversity, Conservation of biodiversity. 2L

Air pollution and control

Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere, Tropopause and Mesopause.

1L

Energy balance: Conductive and Convective heat transfer, radiation heat transfer, simple global temperature model [Earth as a black body, earth as albedo], Problems. 1L

Green house effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level, agriculture and marine food.Global warming and its consequence, Control of Global warming. Earth's heat budget. 1L

Lapse rate: Ambient lapse rate Adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion). 2L

Atmospheric dispersion: Maximum mixing depth, ventilation coefficient, effective stack height, smokestack plumes and Gaussian plume model. 2L

Definition of pollutants and contaminants, Primary and secondary pollutants: emission standard, criteria pollutant.

Sources and effect of different air pollutants- Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN. 2L

Smog, Photochemical smog and London smog.

Depletion Ozone layer: CFC, destruction of ozone layer by CFC, impact of other green house gases, effect of ozone modification. 1L

Standards and control measures: Industrial, commercial and residential air quality standard, control measure (ESP. cyclone separator, bag house, catalytic converter, scrubber (ventury), Statement with brief reference).

1L

Water Pollution and Control

Hydrosphere, Hydrological cycle and Natural water.

Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides, volatile organic compounds. 2L

River/Lake/ground water pollution: River: DO, 5 day BOD test, Seeded BOD test, BOD reaction rate constants, Effect of oxygen demanding wastes on river[deoxygenation, reaeration], COD, Oil, Greases, pH.

2L

Lake: Eutrophication [Definition, source and effect]. 1L

Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only) 1L

Standard and control: Waste water standard [BOD, COD, Oil, Grease],

Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening]

Waste water treatment system, primary and secondary treatments [Trickling filters, rotating biological contractor, Activated sludge, sludge treatment, oxidation ponds] tertiary treatment definition.

2L

Water pollution due to the toxic elements and their biochemical effects: Lead, Mercury, Cadmium, and Arsenic

1L

Land Pollution

Lithosphere; Internal structure of earth, rock and soil 1L

Solid Waste: Municipal, industrial, commercial, agricultural, domestic, pathological and hazardous solid wastes; Recovery and disposal method- Open dumping, Land filling, incineration, composting, recycling.

Solid waste management and control (hazardous and biomedical waste). 2L

Noise Pollution

Definition of noise, effect of noise pollution, noise classification [Transport noise, occupational noise, neighbourhood noise] 1L

Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, $L_{10}(18\,\text{hr Index})$, Ld_n.

Noise pollution control. 1L

Environmental Management:

Environmental impact assessment, Environmental Audit, Environmental laws and protection act of India, Different international environmental treaty/ agreement/ protocol. 2L

References/Books

1. Masters, G. M., "Introduction to Environmental Engineering and Science", Prentice-Hall of India Pvt. Ltd., 1991.
2. De, A. K., "Environmental Chemistry", New Age International.

BIOSENSORS & TRANSDUCERS

Code: BME 402 **Contacts: 3L+1T** **Credits: 4**

M#	Content	Hrs
1	**Transducers principles and Medical applications**: Classification of transducers, characteristic of transducers, Temperature transducers: Resistance temperature detector (RTD), Thermistor, Thermocouple, p-n junction, chemical thermometry, Displacement transducers: potentiometer, resistive strain gauges, inductive displacement, capacitive displacement transducer, Pressure transducer: variable capacitance pressure transducers, LVDT transducers, strain gauge transducers, semiconductor transducers, catheter tip transducers, Piezoelectric transducer, Photoelectric transducers: photo-emissive tubes, photovoltaic cell, photoconductive cell, photodiodes, Flow transducers: magnetic, resistive and ultrasonic	18
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, O_2 electrode, CO_2 electrode.	10
3	**Optical Sensor and Radiation Detectors:** Principles of optical sensors, optical fiber sensors, indicator mediated transducers, optical fiber temperature sensors, Proportional counter, Gas-ionisation chamber, Geiger counters, Scintillation detectors.	6

4	**Biological sensors:** Sensors / receptors in the human body, basic organization of nervous system-neural mechanism, Chemoreceptor: hot and cold receptors, barro receptors, sensors for smell, sound, vision, Ion exchange membrane electrodes, enzyme electrode, glucose sensors, immunosensors, Basic principles of MOSFET biosensors & BIOMEMS, basic idea about Smart sensors.	6

Reference Books:

1. R. S. Khandpur, "Handbook of Biomedical Instrumentation", Tata McGraw Hill.
2. S.C. Cobbold, "Transducers for Biomedcial Instruments", Prentice Hall.
3. Brown & Gann, "Engineering Principles in Physiology Vol. I", Academic Press.
4. Carr & Brown, Introduction to Biomedical Equipment Technology Pearson Edn, Asia.
5. Rao & Guha,"Principles of Medical Electronics & Biomedical Instrumentation", University Press, India.
6. Iberall & Guyton, Regulation & Control in Physiological System, Instruments Soc.USA.
7. A.V.S. De Renck , "Touch Heat & Pain", Churchill Ltd. London.
8. Harry Thomas, "Handbook of Bio medical Instrumentation", Reston, Virginia.
9. D. L. Wise, "Applied Bio Sensors", Butterworth, London.

DIGITAL ELECTRONICS & INTEGRATED CIRCUITS

Code: BME(EC) 402 **Contacts: 3L +1T** **Credits: 4**

M#	Content	Hrs
1	Data and number systems; Binary, Octal and Hexadecimal representation and their conversions; BCD,ASCII, EBDIC, Gray codes and their conversions; Signed binary number representation with 1's and 2's complement methods, Binary arithmetic.	5
2	Venn diagram, Boolean algebra; Various Logic gates- their truth tables and circuits; Representation in SOP and POS forms; Minimization of logic expressions by algebraic method, K-map method and Quine-McClauskey method	6
3	Combinational circuits- Adder and Subtractor circuits; Applications and circuits of Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer and Parity Generator.	5
4	Memory Systems: RAM, ROM, EPROM, EEROM	4
5	Design of combinational circuits-using ROM, Programming logic devices and gate arrays.(PLAs and PLDs)	4
6	Sequential Circuits- Basic memory element-S-R, J-K, D and T Flip Flops, various types of Registers and counters and their design, Irregular counter, State table and state transition diagram, sequential circuits design methodology.	6
7	Different types of A/D and D/A conversion techniques.	4
8	Logic families- TTL, ECL, MOS and CMOS, their operation and specifications.	6

Text Books:

1. Anand Kumar, Fundamentals of Digital Circuits- PHI
2. A.K.Maini- Digital Electronics- Wiley-India
3. Kharate- Digital Electronics- Oxford

References:

1. Morries Mano- Digital Logic Design- PHI
2. R.P.Jain—Modern Digital Electronics, 2/e , Mc Graw Hill
3. H.Taub & D.Shilling, Digital Integrated Electronics- Mc Graw Hill.
4. D.Ray Chaudhuri- Digital Circuits-Vol-I & II, 2/e- Platinum Publishers
5. Givone—Digital Principles & Design, Mc Graw Hill
6. Tocci, Widmer, Moss- Digital Systems,9/e- Pearson
7. S.K.Mandal, Digital Electronics Principles and Applications- Mc Graw Hill.
4. J.Bignell & R.Donovan-Digital Electronics-5/e- Cenage Learning.

8. Leach & Malvino—Digital Principles & Application, 5/e, Mc Graw Hill
9. Floyed & Jain- Digital Fundamentals-Pearson.
10. P.Raja- Digital Electronics- Scitech Publications
11. S.Aligahanan, S.Aribazhagan, Digital Circuit & Design- Bikas Publishing

Practical

COMMUNICATION SKILL & REPORT WRITING
Code: HU 481 Contacts: 3P Credits: 2

Guidelines for Course Execution:

Objectives of this Course: This course has been designed:

1. **To inculcate a sense of confidence in the students.**
2. **To help them become good communicators both socially and professionally.**
3. **To assist them to enhance their power of Technical Communication.**

Detailed Course Outlines:

A. ***Technical Report Writing*** : 2L+6P

1. Report Types (Organizational / Commercial / Business / Project)
2. Report Format & Organization of Writing Materials
3. Report Writing (Practice Sessions & Workshops)

B. ***Language Laboratory Practice***

I. Introductory Lecture to help the students get a clear idea of Technical Communication & the need of Language Laboratory
Practice Sessions 2L
2. Conversation Practice Sessions: (To be done as real life interactions) 2L+4P
a) Training the students by using Language Lab Device/Recommended Texts/cassettes /cd's to get their Listening Skill & Speaking Skill honed
b) Introducing Role Play & honing over all Communicative Competence
3. Group Discussion Sessions: 2L+6P
a) Teaching Strategies of Group Discussion
b) Introducing Different Models & Topics of Group Discussion
c) Exploring Live /Recorded GD Sessions for mending students' attitude/approach & for taking remedial measure
Interview Sessions; 2L+6P

- ***a) Training students to face Job Interviews confidently and successfully***
- ***b) Arranging Mock Interviews and Practice Sessions for integrating Listening Skill with Speaking Skill in a formal situation for effective communication***

4. Presentation: 2L+6P
a) Teaching Presentation as a skill
b) Strategies and Standard Practices of Individual /Group Presentation
c) Media & Means of Presentation: OHP/POWER POINT/ Other Audio-Visual Aids

5. Competitive Examination: 2L+2P
a) Making the students aware of Provincial /National/International Competitive Examinations

b) Strategies/Tactics for success in Competitive Examinations
c) SWOT Analysis and its Application in fixing Target

Books – Recommended:

Nira Konar: English Language Laboratory: A Comprehensive Manual
PHI Learning, 2011

D. Sudharani: Advanced Manual for Communication Laboratories & Technical Report Writing
Pearson Education (W.B. edition), 2011

References:

Adrian Duff et. al. (ed.): Cambridge Skills for Fluency
A) Speaking (Levels 1-4 Audio Cassettes/Handbooks)
B) Listening (Levels 1-4 Audio Cassettes/Handbooks)
Cambridge University Press 1998

Mark Hancock: English Pronunciation in Use
4 Audio Cassettes/CD'S OUP 2004

BIOPHYSICS & BIOCHEMISTRY LABORATORY
Code: BME 491 Contacts: 3P Credits: 2

1. Measurement of pH, and conductivity of body fluid.
2. Measurement of viscosity of Blood
3. Measurement of skin impedance (GSR)
4. Recording and analysis of ECG
5. Recording and analysis of EMG / EEG
6. Determination of muscle Threshold (Fatigue, Twitch, Summation, Incomplete & complete Tetanus)
7. Quantitative estimation of glucose (spectrophotometer / colorimeter)
8. Quantitative estimation of proteins (spectrophotometer / colorimeter)

BIOSENSORS & TRANSDUCERS LABORATORY
Code: BME 492 Contacts: 3P Credits: 2

1. Temperature measurement using AD590 IC sensor
2. Displacement measurement by using a capacitive transducer
3. Study of the characteristics of a LDR
4. Pressure and displacement measurement by using LVDT
5. Study of a load cell with tensile and compressive load
6. Torque measurement Strain gauge transducer
7. Study & characterization of Biotransducers – Pressure, Temparature, Humidity
8. Study & characterization of Bioelectrodes – ECG, EMG, EEG

DIGITAL ELECTRONICS & INTEGRATED CIRCUITS LABORATORY
Code: BME(EC) 492 Contacts: 3P Credits: 2

1. Realization of basic gates using Universal logic gates.
2. Code conversion circuits- BCD to Excess-3 and vice-versa.
3. Four-bit parity generator and comparator circuits.
4. Construction of simple Decoder and Multiplexer circuits using logic gates.
5. Design of combinational circuit for BCD to decimal conversion to drive 7-segment display using multiplexer.

6. Construction of simple arithmetic circuits-Adder, Subtractor.
7. Realization of RS-JK and D flip-flops using Universal logic gates.
8. Realization of Universal Register using JK flip-flops and logic gates.
9. Realization of Universal Register using multiplexer and flip-flops.
10. Construction of Adder circuit using Shift Register and full Adder.
11. Realization of Asynchronous Up/Down counter.
12. Realization of Synchronous Up/Down counter.
13. Design of Sequential Counter with irregular sequences.
14. Realization of Ring counter and Johnson's counter.
15. Construction of adder circuit using Shift Register and full Adder.