# Syllabus for B.Tech (Bio Medical Engineering) up to Fourth Year

Revised Syllabus of B.Tech in BME for the students who were admitted in Academic Session 2010-2011)

## BME SECOND YEAR: THIRD SEMESTER

| A. THEORY | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl.No.** | **Field** | **Theory** | **Contact Hours/Week** | | | | **Cr. Pts** |
| | | | **L** | **T** | **P** | **Total** | |
| 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

| A. THEORY | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl.No.** | **Field** | **Theory** | **Contact Hours/Week** | | | | **Cr. Pts** |
| | | | **L** | **T** | **P** | **Total** | |
| 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<br>1 | 0 | 0 | 2<br>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 (Bio Medical Engineering) up to Fourth Year

Revised Syllabus of B.Tech in BME for the students who were admitted in Academic Session 2010-2011)

**BME 3rd Year**

**Third Year - Fifth Semester**

| A. THEORY | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl.No** | **Field** | **Theory** | **Contact Hours/Week** | | | | **Cr. Pts** |
| | | | **L** | **T** | **P** | **Total** | |
| 1 | **HU - 501** | Economics for Engineers | 3 | 0 | 0 | 3 | 3 |
| 2 | **BME - 501** | Biomedical Instrumentation | 3 | 1 | 0 | 4 | 4 |
| 3 | **BME - 502** | Analytical & Diagnostic Equipments | 3 | 1 | 0 | 4 | 4 |
| 4 | **BME - 503** | Communication Engineering & Bio-Telemetry | 3 | 0 | 0 | 3 | 3 |
| 5 | **BME - 504A**<br>**BME - 504B**<br>**BME - 504C** | Data Structure & C (CSE)<br>Object Oriented Programming & JAVA (IT)<br>Computer Organization (CSE) | 3 | 1 | 0 | 4 | 4 |
| **Total of Theory** | | | | | | **18** | **18** |
| **B. PRACTICAL** | | | | | | | |
| 6 | **BME - 591** | Biomedical Instrumentation Lab | 0 | 0 | 3 | 3 | 2 |
| 7 | **BME - 592** | Biomedical Equipments Lab | 0 | 0 | 3 | 3 | 2 |
| 8 | **BME - 593** | Communication Engineering Lab | 0 | 0 | 3 | 3 | 2 |
| 9 | **BME - 594A**<br>**BME - 594B**<br>**BME - 594C** | Data Structure & C Lab<br>Object Oriented Programming & JAVA Lab<br>Computer Organization Lab | 0 | 0 | 3 | 3 | 2 |
| **Total of Practical** | | | | | | **12** | **8** |
| **Total of Semester** | | | | | | **30** | **26** |

@ The Professional core of one discipline may be taken as Free Elective of the other. For this a scope for including the tutorial as in the Professional core has been included. This will make the credit points earned a little in excess. This gives a variation in the credit points earned.

**Third Year - Sixth Semester**

| A. THEORY | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl.No.** | **Field** | **Theory** | **Contact Hours/Week** | | | | **Cr. Pts** |
| | | | **L** | **T** | **P** | **Total** | |
| 1 | **HU – 601** | Principles of Management | 2 | 0 | 0 | 3 | 2 |
| 2 | **BME - 601** | Therapeutic Equipments | 3 | 0 | 0 | 3 | 3 |
| 3 | **BME - 602** | Biomedical Digital Signal Processing | 3 | 0 | 0 | 3 | 3 |
| 4 | **BME - 603** | Medical Imaging Techniques | 3 | 0 | 0 | 3 | 3 |
| 5 | **BME - 604A**<br>**BME - 604B** | Microprocessors & Microcontrollers (EI)<br>Microelectronics & VLSI Designs (ECE) | 3 | 1 | 0 | 4 | 4 |
| 6 | **BME - 605A**<br>**BME - 605B**<br>**BME - 605C** | Electronic Measurement & Instrumentation<br>Data Base Management System (CSE)<br>Operating System (CSE) | 3 | 0 | 0 | 3 | 3 |
| **Total of Theory** | | | | | | **18** | **18** |
| **B. PRACTICAL** | | | | | | | |
| 7 | **BME - 691** | Medical Instruments Lab | 0 | 0 | 3 | 3 | 2 |
| 8 | **BME - 692** | Biomedical Digital Signal Processing Lab | 0 | 0 | 3 | 3 | 2 |
| 9 | **BME - 694A**<br>**BME - 694B** | Microprocessor & Microcontroller Lab<br>VLSI Design Lab | 0 | 0 | 3 | 3 | 2 |
| 10 | **BME - 696** | Seminar | 0 | 0 | 3 | 3 | 2 |
| **Total of Practical** | | | | | | **12** | **8** |
| **Total of Semester** | | | | | | **30** | **26** |

* There may be a limited choice between only two papers which become quasi compulsory.

# Syllabus for B.Tech (Bio Medical Engineering) up to Fourth Year

Revised Syllabus of B.Tech in BME for the students who were admitted in Academic Session 2010-2011)

**Fourth Year - Seventh Semester**

| Sl. No. | Field | Theory | Contact Hours/Week | | | | Cr. Pts |
|---|---|---|---|---|---|---|---|
| | | | L | T | P | Total | |
| | | **A. THEORY** | | | | | |
| 1 | **BME - 701** | Biomaterials & Tissue Engineering | 3 | 0 | 0 | 3 | 3 |
| 2 | **BME - 702** | Biomechanics & Implants | 3 | 0 | 0 | 3 | 3 |
| 3 | **BME - 703A**<br>**BME - 703B** | Medical Image Processing<br>Adaptive Signal Processing | 3 | **1** | 0 | 4 | 4 |
| 4 | **BME - 704A**<br>**BME - 704B** | Advanced Medical Imaging Techniques<br>Virtual Instrumentation | 3 | 0 | 0 | 3 | 3 |
| 5 | **BME - 705A**<br>**BME - 705B**<br>**BME - 705C** | Power & Control System<br>Biological Control System & Modelling<br>Artificial Intelligence & Pattern Recognition | 3 | 1 | 0 | 4 | 4 |
| | | **Total of Theory** | | | | **17** | **17** |
| | | **B. PRACTICAL** | | | | | |
| 6 | **HU - 791** | Group Discussion | 0 | 0 | 0 | 3 | 2 |
| 7 | **BME - 791** | Biomaterials & Biomechanics Lab | 0 | 0 | 3 | 3 | 2 |
| 8 | **BME - 792** | Biomedical Instruments & System Lab | 0 | 0 | 3 | 3 | 2 |
| 9 | **BME - 793A**<br>**BME - 793B** | Medical Image Processing Lab<br>Adaptive Signal Processing Lab | 0 | 0 | 3 | 3 | 2 |
| 10 | **BME-794** | **Industrial training** | **4 wks during 6th -7 th Sem-break** | | | | 2 |
| 11 | **BME-795** | **Project- 1** | | | 6 | | 2 |
| | | **Total of Practical** | | | | **18** | **12** |
| | | **Total of Semester** | | | | **35** | **29** |

* One may be the P.C. of a different discipline.

**Fourth Year - Eighth Semester**

| Sl. No. | Field | Theory | Contact Hours/Week | | | | Cr. Pts |
|---|---|---|---|---|---|---|---|
| | | | L | T | | | |
| | | **A. THEORY** | | | | | |
| 1 | **HU – 801A** | Organisational Behaviour | 2 | 0 | 0 | 2 | 2 |
| 2 | **BME - 801A**<br>**BME - 801B** | Artificial Organs & Rehabilitation Engineering<br>Lasers & Fiber Optics in Medicine | 3 | 1 | 0 | 4 | 4 |
| 3 | **BME - 802A**<br>**BME - 802B**<br>**BME - 802C** | Health Technology Management<br>Medical Informatics<br>Neural Network & Fuzzy Logic Control | 3 | 1 | 0 | 4 | 4 |
| | | **Total of Theory** | | | | **10** | **10** |
| | | **B. PRACTICAL** | | | | | |
| 4 | **BME - 891** | Seminar / PPt preparation etc on a topic of interest | 0 | 0 | 3 | 3 | 2 |
| 5 | **BME - 892** | Design Lab / Industrial problem related practical training | 0 | 0 | 6 | 6 | 4 |
| 6 | **BME - 893** | Project-2 | 0 | 0 | 12 | 12 | 6 |
| 7 | **BME-894** | **Grand Viva** | | | | | 3 |
| | | **Total of Practical** | | | | **21** | **15** |
| | | **Total of Semester** | | | | **31** | **25** |

# Depending on the type of electives chosen, total credit points may vary from 212 to 218. Average credits earned is 215.

$ If the total credit points earned is to be reduced below the minimum credit points of 210, then the Professional & Free Electives that are be taken in the final semester may be termed as Audit point papers. This will bring down the range of credit points earned from the range 210-218 to 204-214. But this will be a marginal reduction

# Syllabus for B.Tech (Bio Medical Engineering) up to Fourth Year

Revised Syllabus of B.Tech in BME for the students who were admitted in Academic Session 2010-2011)

**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, | 8 |

| | | |
|---|---|---|
| | immunity and antibodies, Blood Groups and blood transfusion. | |
| 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.

# Syllabus for B.Tech (Bio Medical Engineering) up to Fourth Year

Revised Syllabus of B.Tech in BME for the students who were admitted in Academic Session 2010-2011)

**SEMESTER – V**

**THEORY**

**SEMESTER - V**
**Theory**

**Economics for Engineers**
**HU-501**
**Contracts: 3L** **Credits- 3**

1. Economic Decisions Making – Overview, Problems, Role, Decision making process.
2. Engineering Costs & Estimation – Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring And Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life-Cycle Costs; Types Of Estimate, Estimating Models - Per-Unit Model, Segmenting Model, Cost Indexes, Power-Sizing Model, Improvement & Learning Curve, Benefits.
3. Cash Flow, Interest and Equivalence: Cash Flow – Diagrams, Categories & Computation, Time Value Of Money, Debt repayment, Nominal & Effective Interest.
4. Present Worth Analysis : End-Of-Year Convention, Viewpoint Of Economic Analysis Studies, Borrowed Money
Viewpoint, Effect Of Inflation & Deflation, Taxes, Economic Criteria, Applying Present Worth Techniques, Multiple Alternatives.
5. Cash Flow & Rate Of Return Analysis – Calculations, Treatment of Salvage Value, Annual Cash Flow Analysis, Analysis Periods; Internal Rate Of Return, Calculating Rate Of Return, Incremental Analysis; Best Alternative Choosing An Analysis Method, Future Worth Analysis, Benefit-Cost Ratio Analysis, Sensitivity And Breakeven Analysis. Economic Analysis In The Public Sector - Quantifying And Valuing Benefits & drawbacks.
6: Uncertainty In Future Events - Estimates And Their Use In Economic Analysis, Range Of Estimates, Probability, Joint Probability Distributions, Expected Value, Economic Decision Trees, Risk, Risk vs Return, Simulation, Real Options.
7. Depreciation - Basic Aspects, Deterioration & Obsolescence, Depreciation And Expenses, Types Of Property,
Depreciation Calculation Fundamentals, Depreciation And Capital Allowance Methods, Straight-Line Depreciation
Declining Balance Depreciation, Common Elements Of Tax Regulations For Depreciation And Capital Allowances.
8. Replacement Analysis - Replacement Analysis Decision Map, Minimum Cost Life Of A New Asset, Marginal Cost, Minimum Cost Life Problems.
9. Inflation And Price Change – Definition, Effects, Causes, Price Change With Indexes, Types of Index, Composite vs Commodity Indexes, Use of Price Indexes In Engineering Economic Analysis, Cash Flows that inflate at different Rates.
10. Accounting – Function, Balance Sheet, Income Statement, Financial Ratios Capital Transactions, Cost Accounting, Direct and Indirect Costs, Indirect Cost Allocation.

***Readings***


1. James L.Riggs,David D. Bedworth, Sabah U. Randhawa : Economics for Engineers 4e , Tata McGraw-Hill
2. Donald Newnan, Ted Eschembach, Jerome Lavelle : Engineering Economics Analysis, OUP
3. John A. White, Kenneth E.Case,David B.Pratt : Principle of Engineering Economic Analysis, John Wiley
4. Sullivan and Wicks: Engineering Economy, Pearson
5. R.Paneer Seelvan: Engineering Economics, PHI
6. Michael R Lindeburg : Engineering Economics Analysis, Professional Pub


**Biomedical Instrumentation**
Code: BME 501
Contact: 3L + IT Credit: 4

| | |
|---|---|
| **Medical Instrumentation**: Sources of Biomedical Signals, Basic medical Instrumentation system, Performance requirements of medical Instrumentation system, Microprocessors in medical instruments, PC based medical Instruments, General constraints in design of medical Instrumentation system, Regulation of Medical devices. | **6L** |
| **Measurement systems**: Specifications of instruments, Static & Dynamic characteristics of medical instruments, Classification of errors, Statistical analysis, Reliability, Accuracy, Fidelity, Speed of response, Linearization of technique, Data Acquisition System. | **6L** |
| **Bioelectric signals and Bioelectric amplifiers:** Origin of bioelectric signals, Electrodes, Electrode-tissue interface, Galvanic Skin Response, BSR, Motion artifacts, Instrumentation amplifiers, Special features of bioelectric amplifiers, Carrier amplifiers, Chopper amplifiers, Phase sensitive detector. | **8L** |
| **Biomedical recording systems:** Basic Recording systems, General consideration for signal conditioners, Preamplifiers, Differential Amplifier, Isolation Amplifier, Electrocardiograph, Vectorcardiograph, Phonocardiograph, Electroencephalograph, Electromyography, Other biomedical recorders, Biofeedback instrumentation, Electrostatic and Electromagnetic coupling to AC signals, Proper grounding, Patient isolation and accident prevention. | **12L** |
| **Patient Monitoring Systems:** System concepts, Cardiac monitor, selection of system parameters, Bedside monitors, Central monitors, Heart rate meter, Pulse rate meter, Holter monitor and Cardiac stress test, Cardiac cauterization instrumentation, Organization and equipments used in ICCU & ITU. | **8L** |
| **Total** | **40L** |

**Text Books:**

1. R. S. Khandpur "Handbook of Bio-Medical Instrumentation", 2nd Edition, Tata McGraw Hill.
2. J.J.Carr & J.M.Brown, "Introduction to Biomedical Equipment Technology" Pearson Education, Asia.
3. Cromwell, Weibell & Pfeiffer, "Biomedical Instrumentation & Measurement", Prentice Hall, India

**References:**

1. Joseph Bronzino, "Biomedical Engineering and Instrumentation", PWS Engg . , Boston.
2. J.Webster, "Bioinstrumentation", Wiley & Sons.
3. Joseph D.Bronzino, "The Biomedical Engineering handbook", CRC Press.

**Analytical & Diagnostic Equipments**
**Code: BME 502**
**Contact: 3L + IT** Credit: 4

| | |
|---|---|
| **Clinical equipments**: Principles of photometric measurement, Radiation sources, Optical filters, Colorimeter, Spectrometer, Design of Monochromators, Flame photometer, Atomic absorption spectrophotometer, Automated biochemical analyzer-Auto analyzer, Electromechanical analyzer – Chromatographs, Microscopes, Scanning Electron Microscope, Transmission Electron Microscope, Centrifuge-principles and applications. | **12L** |
| ***Blood gas analyzers and Oximeters:*** Blood pH measurement, Blood $pCO_2$ measurement, Blood $pO_2$ measurement, a complete blood gas analyzer, Fiber optic based blood gas sensors, Oximetry, Principles of oximetric measurements, Ear oximeter, Pulse oximeter, Intravascular oximeter. | **6L** |
| **Blood cell counters and Blood pressure apparatus:** Methods of cell counting, Flow cytometry, Coulter Counters, automatic recognition and differential counting of cells, **S**phygmomanometer, Automated indirect and Specific direct method of B.P. monitor. | **6L** |
| ***Blood Flow meters***: Electromagnetic blood flow meter, Ultrasonic blood flow meter-Transit time and Doppler blood flow meter, Cardiac output measurement-Dye dilution method and Impedance technique. | **6L** |
| **Pulmonary function analyzers:** Respiratory volumes and capacities, Compliance and related pressure, Spirometer, Pneumotachometer, impedance pneumograph / plethysmograph, apnea detector. | **6L** |
| **Endoscopy:** Basic endoscopic equipments, Fibreoptic instruments and video-endoscopes, Accessories-illumination, instrument tips, instrument channels, tissue sampling devices, suction traps and fluid-flushing devices, Various endoscopic applications. | **4L** |
| **Total** | **40L** |

**Text Books:**

1. R. S. Khandpur "Handbook of Bio-Medical Instrumentation", 2nd Edition, Tata McGraw Hill.
2. J.J.Carr & J.M.Brown, "Introduction to Biomedical Equipment Technology" Pearson Education, Asia.
3. Cromwell, Weibell & Pfeiffer, "Biomedical Instrumentation & Measurement", Prentice Hall, India

**References:**

1. Joseph Bronzino, "Biomedical Engineering and Instrumentation", PWS Engg . , Boston.
2. J.Webster, "Bioinstrumentation", Wiley & Sons.
3. Joseph D.Bronzino, "The Biomedical Engineering handbook", CRC Press.

**Communication Engineering & Bio-Telemetry**
Code: BME 503
Contact: 3L Credit: 3

| | |
|---|---|
| **Introduction:** Elements of analog and digital communication system, Baseband communication, Carrier communication, Concept of Modulation, Source coding, Channel coding. | **2L** |
| **Analog Communication:** Amplitude modulation (AM)-Frequency domain & time domain representation, Modulation index, Transmission bandwidth, Single tone & multitone modulation, Power calculation for single tone, Generation and demodulation of AM, Generation and demodulation of Single side band modulation (SSB), Generation and demodulation of Double side band suppressed carrier modulation (DSBSC/DSB), Super heterodyne receiver for AM Radio, Angle Modulation(FM/PM)- Frequency modulation, Phase modulation, Time & frequency domain representation of FM, Narrow band & wideband FM, Generation and detection of FM, Introduction to Phase-Locked-Loop(PLL), Demodulation of PM using PLL. | **12L** |
| **Digital Communication:** Concept of sampling, Pulse Amplitude Modulation(PAM), Pulse Code Modulation(PCM), delta modulation and adaptive delta modulation, Digital transmission, Line coding- Unipolar, Polar, NRZ, RZ, Manchester and AMI, Coding control, Digital Modulation Techniques-ASK, PSK, FSK and QPSK, Multiplexing-FDM and TDM. | **13L** |
| **Bio-Telemetry System:** Components of telemetry system, Bio-telemetry and its importance, Single and multi-channel biotelemetry, ECG telemetry system, Temperature telemetry system, Telemetry of ECG and Respiration, Sports telemetry, Multi-patient telemetry, Ambulatory patient monitoring, Implantable telemetry systems, transmission of physiological signals over telephone line, Telemedicine and applications, | **7L** |
| **Total** | **34L** |

***Text Books:***

1. P Ramakrishna Rao , "Analog Communication",., Mc-Graw Hill
2. B.P.Lathi -Communication Systems- BS Publications
3. V Chandra Sekar – Analog Communication- Oxford University Press
4. S. Haykin, - Digital Communications, Wiley India.
5. H. Taub and D.L.Schilling -Principles of Communication Systems, TMH Publishing Co.
6. J.G.Proakis - Digital Communications, TMH Publishing Co.
7. R. S. Khandpur " Handbook of Bio-Medical Instrumentation", 2n Ed. Tata McGraw Hill.

***References:***

1. A.B.Carlson—Communication System,4/e ,Mc-Graw Hill
2. Proakis & Salehi Fundamentals of Communication Systems- Pearson
3. Singh & Sapre—Communication Systems: 2/e, TMH
4. P K Ghosh- Principles of Electrical Communications- University Press
5. Blake, Electronic Communication Systems- Cengage Learning
6. S Sharma, Analog Communication Systems- Katson BooksMillman & Halkias,
7. B.P.Lathi and Z.Ding,Modern Digital and Analog Communication Systems, Oxford University Press.
8. A. Bhattacharya - Digital Communication, TMH Publishing Co.


**Data Structure & C**
**Code: BME-504A**
**Contacts: 3L +1T** **Credits: 4**

**Module -I. [8L] Linear Data Structure**
**Introduction (2L)**:
Why we need data structure? Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type. Algorithms and programs, basic idea of pseudo-code. Algorithm efficiency and analysis, time and space analysis of algorithms – order notations.
**Array (2L):**
Different representations – row major, column major. Sparse matrix - its implementation and usage. Array representation of polynomials.
**Linked List (4L)**:
Singly linked list, circular linked list, doubly linked list, linked list representation of polynomial and applications.

**Module -II: [7L] Linear Data Structure**
**[Stack and Queue (5L)**:
Stack and its implementations (using array, using linked list), applications. Queue, circular queue, dequeue. Implementation of queue- both linear and circular (using array, using linked list), applications.
**Recursion (2L)**:
Principles of recursion – use of stack, differences between recursion and iteration, tail recursion. Applications - The Tower of Hanoi, Eight Queens Puzzle.

**Module -III. [15L] Nonlinear Data structures**
**Trees (9L):**
Basic terminologies, forest, tree representation (using array, using linked list). Binary trees - binary tree traversal (pre-, in-, post- order), threaded binary tree (left, right, full) - non-recursive traversal algorithms using threaded binary tree, expression tree. Binary search tree- operations (creation, insertion, deletion, searching). Height balanced binary tree – AVL tree (insertion, deletion with examples only). B- Trees – operations (insertion, deletion with examples only).
**Graphs (6L)**:
Graph definitions and concepts (directed/undirected graph, weighted/un-weighted edges, sub-graph, degree, cutvertex/articulation point, pendant node, clique, complete graph, connected components – strongly connected component, weakly connected component, path, shortest path, isomorphism). Graph representations/storage implementations – adjacency matrix, adjacency list, adjacency multi-list. Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS) – concepts of edges used in DFS and BFS (tree-edge, back-edge, cross-edge, forward-edge), applications. Minimal spanning tree – Prim's algorithm (basic idea of greedy methods).

**Module - IV. Searching, Sorting (10L):**
**Sorting Algorithms (5L):** Bubble sort and its optimizations, insertion sort, shell sort, selection sort, merge sort, quick sort, heap sort (concept of max heap, application – priority queue), radix sort.
**Searching (2L):** Sequential search, binary search, interpolation search.
**Hashing (3L):** Hashing functions, collision resolution techniques.
**Recommended books:**


1. "Data Structures And Program Design In C", 2/E by Robert L. Kruse, Bruce P. Leung.
2. "Fundamentals of Data Structures of C" by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed.
3. "Data Structures in C" by Aaron M. Tenenbaum.
4. **"**Data Structures" by S. Lipschutz.
5. "Data Structures Using C" by Reema Thareja.
6. "Data Structure Using C", 2/e by A.K. Rath, A. K. Jagadev.
7. **"**Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein.

**Object Oriented Programming & JAVA**
**Code: BME-504B**
**Contacts: 3L + 1T** **Credits: 4**

**Module-1:** [10L]
**Introduction:**
Why object orientation, History and development of object oriented programming language, concepts of object oriented programming language. [1L] Difference between OOP and other conventional programming –advantages and disadvantages. [1L] Data types, variables. Array, operators. [1L] String, I/O. [1L] Control statements. [1L]
**Object oriented design:**
Major and minor elements, class fundamentals. [1L]; Declaring objects, instantiation of class, introducing methods. [1L]; Constructing objects using constructor. [1L]; Static variable, constants. [1L]; Visibility modifiers. [1L]
Learning outcome of Introduction of OOP: Students will be able to implement basic data structure and control statements in object oriented programming. They can write programs around its data i.e, objects and a set of well-defined interfaces to that data. Student will be able to design class with its basic features.
**Module-2:** [8L]
**Object Properties:**
Introduction to basic features of a class (encapsulation, polymorphism etc) [1L]; Data field encapsulation. [1L]; Passing objects to methods. [1L]; Array of objects, 'This' keyword [1L]; Relationships among objects: aggregation, composition, dependency, links. [1L]; Relationship among classes: association, aggregation. [1L] Meta class, meta object. [1L]; Grouping constructs. [1L] Learning outcome of Object oriented design: Student will be able to design object oriented programs with the concept of object, class, abstraction, encapsulation, inheritance etc. to provide flexibility, modularity and re-usability in programming. They can also be able to design Meta classes and grouping construct.
**Module-3:** [11L]
**Basic concepts of object oriented programming using Java:**
Using objects as parameters, closure look at argument passing, returning objects. [1L]; Introducing access control, Final keyword, garbage collection, Nested and inner classes. [1L]; Class abstraction and encapsulation, Overloading of methods (overloading of constructor). [1L]; Super class, subclasses, super keyword, inheritance, types, member access.[1L]; Multilevel hierarchy, process of constructor calling in inheritance. [1L]; Overriding methods, overriding vs. overloading, polymorphism. [1L]; Abstract class, interface & comparison between abstract class and interface [1L]; Packages, importing packages. [1L]; Exception handling basics, types, using try &catch, throw, throws & finally. [1L]; Threading, synchronization & priorities, thread class, creating thread. [1L]; Basic applet programming. Life cycle. [1L];
Learning outcome of OOP using Java: Students can write programs using Java to implement OOP i.e, encapsulation, polymorphism, aggregation etc., by which they will be able to compare the difference between OOP and other conventional programming languages. They will write programs by using the built-in support for multithreaded programming in java. They will also implement the GUI based event-driven application using Java applets.
**Module-4:** [8L]
**Fundamentals of Object Oriented design in UML:**
Introduction to UML: Why Modeling, Overview of UML, Conceptual Model, Architecture of UML [1L]; UML Modeling Types: Structural Modeling, Behavioral Modeling, Architectural Modeling [1L]; Basic Notations in UML [1L]; Class Diagram [1L]; Interaction and Collaboration Diagrams. [1L]; Sequence Diagram. [1L]; State chart Diagram and Activity Diagram. [1L]; Implementation Diagram and UML extensibility-model constraints.[1L]
Learning outcome of Object oriented design in UML:
Student will be able to design software through UML diagrams and identify the components of object oriented design and develop the relationship among them. They can also able to use UML to design software like Payroll Management System, Library Management System etc.
**Textbooks/References:**

1. Rambaugh, James Michael, Blaha-"Object Oriented Modelling and Design"-Prentice Hall, India
2. Ali Bahrami,-"Object Oriented System Development"-Mc Graw Hill
3. Patrick Naughton, Herbert Schildt-"The complete reference-Java2"-TMH
4. Sourav Sahay-"Object-Oriented Programming with C++"-Oxford
5. Jason T. Roff, UML: A Beginner's Guide, TMH
6. Grady Booch, Ivar Jacobson,James Rumbaugh,"The Unified Modeling Language Reference Manual",Pearson Ed.
7. Blaha, Rumbaugh, "Object-Oriented Modeling and Design with UML", Pearson Ed.


**Computer organization**
**Code: BME-504C**
**Contacts: 3L +1T** **Credits: 4**

**Module – 1:** [8L]
Basic organization of the stored program computer and operation sequence for execution of a program. Role of operating systems and compiler/assembler. Fetch, decode and execute cycle, Concept of operator, operand, registers and storage, Instruction format. Instruction sets and addressing modes. [7L] Commonly used number systems. Fixed and floating point representation of numbers. [1L]

**Module – 2:** [8L]
Overflow and underflow. Design of adders - ripple carry and carry look ahead principles. [3L] Design of ALU. [1L]

Fixed point multiplication -Booth's algorithm. [1L] Fixed point division - Restoring and non-restoring algorithms. [2L] Floating point - IEEE 754 standard. [1L]

**Module – 3**: [10L]
Memory unit design with special emphasis on implementation of CPU-memory interfacing. [2L] Memory organization, static and dynamic memory, memory hierarchy, associative memory. [3L] Cache memory, Virtual memory. Data path design for read/write access. [5L]

**Module – 4**: [10L]
Design of control unit - hardwired and microprogrammed control. [3L] Introduction to instruction pipelining. [2L] Introduction to RISC architectures. RISC vs CISC architectures. [2L] I/O operations - Concept of handshaking, Polled I/O, interrupt and DMA. [3L]

**Learning Outcome:**
**Additional Tutorial Hours will be planned to meet the following learning outcome.**
Through this course, the students will be exposed to extensive development and use of computer organization based concepts for the future knowledge outcome of Advanced Computer Architecture offered in subsequent semester. The students will be able to understand different instruction formats, instruction sets, I/O mechanism. Hardware details, memory technology, interfacing between the CPU and peripherals will be transparent to the students. Students will be able to design hypothetical arithmetic logic unit.

**Text Book:**

1. Mano, M.M., “Computer System Architecture”, PHI.
2. Behrooz Parhami “ Computer Architecture”, Oxford University Press

**Reference Book:**

1. Hayes J. P., “Computer Architecture & Organisation”, McGraw Hill,
2. Hamacher, “Computer Organisation”, McGraw Hill,
3. N. senthil Kumar, M. Saravanan, S. Jeevananthan, “Microprocessors and Microcontrollers” OUP
4. Chaudhuri P. Pal, “Computer Organisation & Design”, PHI,
5. P N Basu- “Computer Organization & Architecture” , Vikas Pub


**Practical**

**Biomedical Instrumentation Lab**
Code: BME 591
Contacts: 3P Credits: 2

**List of experiments:**
1. Power isolation: isolation transformer and DC-DC converters
2. Timer circuits: ON delay and OFF delay study
3. Characterization of biopotential amplifier for ECG & EMG signals
4. Isolation of bio-signal (EMG / ECG)
5. ECG processing and analysis
6. EMG processing and analysis
7. EEG processing and analysis
8. PCG processing and analysis / electronic stethoscope
9. Detection of QRS component from ECG signals
10. Measurement of heart rate using F-V converter

**Biomedical Equipments Lab**
Code: BME 592
Contacts: 3 P Credits: 2

[Demonstration and /or study of working of the following biomedical equipments to understand the applications & technology involved in these equipments- using student training kits & simulator.]

**List of experiments:**
1. Study on colorimeter
2. Study on flame photometer
3. Study on spectrophotometer
4. Study on autoanalyzer / cell counter
5. Study on electronic BP and calibration procedure
6. Study of ultrasonic devices - transmitter and detector
7. Study on blood flow velocity measurement - ultrasonic method
8. Study on pulmonary function analyzer - spirometer
9. Study on respiratory rate meter & apnea detection
10. Study on pulse oximeter

**Communication Engineering Lab**
Code: BME 593
Contact: 3P Credit: 2

**List of experiments:**

1. Measurement of MI of an AM signal
2. Study of SSB modulation and demodulation technique
3. Study of DSB modulation and demodulation technique
4. Measurement of bandwidth of a FM signal
5. Study of phase locked Loop (PLL)
6. Study process of PAM and demodulation technique
7. Study of PCM coder and decoder
8. Study of PSK modulation and demodulation technique
9. Study of FSK modulation and demodulation technique
10. Study of Time Division Multiplexing (TDM) and Demultiplexing

**Data Structure & C Lab**
**Code: BME-594A**
**Contacts: 3 Credits: 2**

Experiments should include but not limited to :

Implementation of array operations:
Stacks and Queues: adding, deleting elements Circular Queue: Adding & deleting elements Merging Problem :
Evaluation of expressions operations on Multiple stacks & queues :
Implementation of linked lists: inserting, deleting, inverting a linked list. Implementation of stacks & queues using linked lists:
Polynomial addition, Polynomial multiplication
Sparse Matrices : Multiplication, addition.
Recursive and Nonrecursive traversal of Trees
Threaded binary tree traversal. AVL tree implementation
Application of Trees. Application of sorting and searching algorithms
Hash tables implementation: searching, inserting and deleting, searching & sorting techniques.

**Object Oriented Programming & JAVA Lab**
**Code: BME-594B**
**Contacts: 3 Credits: 2**

1. Assignments on class, constructor, overloading, inheritance, overriding
2. Assignments on wrapper class, vectors, arrays
3. Assignments on developing interfaces- multiple inheritance, extending interfaces
4. Assignments on creating and accessing packages
5. Assignments on multithreaded programming, handling errors and exceptions, applet programming and graphics programming

Note: Use Java for programming.

**Computer Organization Lab**
**Code: BME-594C**
**Contacts: 3 Credits: 2**

1. Familiarity with IC-chips, e.g.
a) Multiplexer , b) Decoder, c) Encoder b) Comparator
Truth Table verification and clarification from Data-book.
2. Design an Adder/Subtractor composite unit .
3. Design a BCD adder.
4. Design of a 'Carry-Look-Ahead' Adder circuit.
5. Use a multiplexer unit to design a composite ALU .
6. Use ALU chip for multibit arithmetic operation.
7. Implement read write operation using RAM IC.
8. (a) & (b) Cascade two RAM ICs for vertical and horizontal expansion.

# Syllabus for B.Tech (Bio Medical Engineering) up to Fourth Year

Revised Syllabus of B.Tech in BME for the students who were admitted in Academic Session 2010-2011)

**SEMESTER - VI**
**Theory**

**Principles of Management**
**HU-601**
**Contracts: 2L**
**Credits- 2**

1. Basic concepts of management: Definition – Essence, Functions, Roles, Level.
2. Functions of Management : Planning – Concept, Nature, Types, Analysis, Management by objectives; Organisation Structure – Concept, Structure, Principles, Centralization, Decentralization, Span of Management; Organisational Effectiveness.
3. Management and Society – Concept, External Environment, CSR, Corporate Governance, Ethical Standards.
4. People Management – Overview, Job design, Recruitment & Selection, Training & Development, Stress Management.
5. Managerial Competencies – Communication, Motivation, Team Effectiveness, Conflict Management, Creativity, Entrepreneurship
6. Leadership: Concept, Nature, Styles.
7. Decision making: Concept, Nature, Process, Tools & techniques.
8. Economic, Financial & Quantitative Analysis – Production, Markets, National Income Accounting, Financial Function & Goals, Financial Statement & Ratio Analysis, Quantitative Methods – Statistical Interference, Forecasting, Regression Analysis, Statistical Quality Control.
9. Customer Management – Market Planning & Research, Marketing Mix, Advertising & Brand Management.
10. Operations & Technology Management – Production & Operations Management, Logistics & Supply Chain Management, TQM, Kaizen & Six Sigma, MIS.

**Readings:**
1. Management : Principles, Processes & Practices – Bhat, A & Kumar, A (OUP).

**Therapeutic Equipments**
Code: BME 601
Contact: 3L Credit: 3

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|---|---|
| **Cardiac Pacemakers & Defibrillators:**. Effects of electric field on cardiac muscles and laws of stimulation, Need for pacemaker, External pacemakers, Implantable pacemakers and types, codes for pacemakers, Pulse generator and Power sources, Electrodes and leads system, Pacing system analyzers, Programmable pacemakers, Rate-responsive and ventricular synchronous pacemakers, Microprocessor based modern pacemakers, Need for defibrillators, DC defibrillator, Synchronous operation, Implantable defibrillators, defibrillator analyzers and safety. | **10L** |
| **Ventilators & Anaesthetic system:** Artificial ventilations, Ventilators and types, Terminology of ventilators, Classification of ventilators and modern ventilators, Need for anaesthesia, Anaesthesia gases and vapors, Anaesthesia delivery system, Humidifiers, Nebulizers and Aspirators. | **6L** |
| **Physiotherapy & Electrotherapy Equipments:** IR diathermy, UV diathermy, Short wave diathermy, Microwave diathermy, Ultrasonic diathermy, Electrotherapy and different waveforms, Electrode system, Electrical stimulators and types, Nerve-muscle stimulators, Ultrasonic stimulators**,** Pain relief through electrical stimulators. | **7L** |
| **Surgical Diathermy & LASER:** Principles and applications of surgical diathermy, Electrosurgery machine, electrosurgery circuits, Different electrodes, Electrosurgery techniques, solid state electrosurgery, generator circuits, Testing of Electrosurgery units, electrosurgery safety, Basic principle of ultrasonic lithotripter and extracorporeal shock wave lithotripter, Principle operation of LASER, various application of $CO_2$, Ar,, He -Ne, Nd – YAG & pulsed ruby LASER, Application of LASER in surgery. | **8L** |
| **Neonatal Care and Drug Delivery Systems:** Baby incubator, radiant warmer and phototherapy unit, Suction apparatus, Infusion pumps, Syringe pumps, Peristaltic pumps, Implantable infusion pumps, Programmable volumetric pumps. | **3L** |
| **Total** | **34L** |

**Text Books:**
1. R. S. Khandpur “Handbook of Bio-Medical Instrumentation”, 2nd Edition, Tata McGraw Hill.
2. J.J.Carr & J.M.Brown, “Introduction to Biomedical Equipment Technology” Pearson Education, Asia.
3. J.Webster, “Bioinstrumentation”, Wiley & Sons

**References:**
1. Joseph Bronzino, “ Biomedical Engineering and Instrumentation”, PWS Engg . , Boston.
2. Willard Van Nostrand, “.Instrumental Methods of Analysis”-
3. Sharms, “Instrumental Methods”, S Chand & Co.
4. Harry Bronzino E, “Handbook of Biomedical Engineering and Measurements”, Reston, Virginia.
5. Jacobson & Websler, “ Medicine & Clinical Engg”
6. Leslie Cromwell, “ Biomedical Instrumentation and Measurements”

7. Hcinz Kressc, " Handbook of Electro medicine" , John Wiley.
8. Geddes & Baker , "Principles of Applied Biomedical Instrumentation" Wiley.
9. Ward's Anaesthesia Equipments-4th Ed-Edited by C Ward

**Biomedical Digital Signal Processing**
Code: BME 602
Contact: 3L Credit: 3

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|---|---|
| **Introduction:** Concept of discrete-time signal, Basic idea of sampling and reconstruction of signal, Sampling theorem, Simple signal conversion systems, Frequency domain representation, Spectral analysis, Cepstral analysis, Linear filtering, adaptive filters-general structure, LMS adaptive filter, Noise cancellation, Feature extraction and pattern recognition, Brief idea about - Short Time Fourier Transform (STFT) and Wavelet | **9L** |
| **Digital Filters Realizations:** Characteristics of FIR filters, frequency response, Design of FIR filters using Windowing Techniques, Analog filter approximations-Butterworth and Chebychev, Design of IIR filters-Bilinear transformation method, Step and Impulse invariance techniques, Spectral transformations, Comparison of FIR and IIR filters. | **7L** |
| **Cardiological and Electromuscular signal processing:** Basic Electrocardiography, ECG Data Acquisition, QRS detection, Rhythm analysis, Arrhythmia detection algorithms, Automated ECG analysis, ECG pattern recognition, Basic electromyography, EMG data acquisition, Rectification and averaging. | **9L** |
| **Neurological signal processing:** The EEG Signals and its characteristics, EEG Analysis-Time frequency domain method, Linear prediction theory and Autoregressive (A.R.) method, Detection of spikes and spindles, Detection of alpha, beta and gamma waves. Least squares and polynomial modelling-Markov Model and Markov Chain, Dynamics of Sleep-Wake Transition, Hypnogram Model Parameters, Analysis of evoked potential using Prony's method. | **9L** |
| **Data compression techniques:** Data reduction algorithms-TP, AZTEC, CORTES and KL transform with special example to ECG signal. | **4L** |
| **Total** | **34 L** |

***Text Books:***
1. D.C.Reddy, " Biomedical signal processing – Principles and Technique", Tata McGraw-Hill.
2. Wills J. Tompkins, " Biomedical digital signal processing", Prentice Hall of India Pvt. Ltd.
3. Digital biosignal processing. Weitkunat R, Elsevier.
4. Computer technique in medicine. Macfarlane P.W. Butter Worth
5. L.R.Rabiner & B.Gold, "Theory and application of Digital Signal Processing".
6. S.K.Mitra, "Digital Signal Processing : A computer based approach", TMH.
7. J.G.Prokis & D.G.Manolakis, "Digital Signal Processing: Principles, Algorithm and Applications", PHI/Pearson Education.
8. S.Salivahanan et al, "Digital Signal Processing", TMH.

***Reference:***
1. Oppenheim & Ronald W Schafer," Digital Signal Processing", Prentice Hall India.
2. Andreas Antonion , "Digital Filters Analysis & Design", Prentice Hall India.
3. R Rabiner & B. Gold , "Theory & Application of Digital Signal processing", PHI.

**Medical Imaging Techniques**
Code: BME-603
Contact: 3L Credit: 3

| | |
|---|---|
| **X-ray Machine*:*** Physics and production of X-ray, Stationary and rotating anode tube, tube enclosure, rating charts of X-ray tubes, Conventional electrical circuit of X-ray machine, High voltage generation, High frequency generators, Control circuits-high voltage control, filament control and tube current, starter, exposure timing, Automatic exposure control, Collimators and Grids, mammographic and dental X-ray machines, portable and mobile X-ray units. | **10L** |
| **X-ray image and radiotherapy:** X-ray film, Film sensitometry, Radiographic film image formation, dark room accessories-developer and fixer, image quality factors, detector quantum efficiency, MTF, Image intensifier, Digital radiography, safety protocol and doses, Dose equivalent and REM, Radiotherapy principles, dose measurement and treatment planning. | **7L** |
| **Fluoroscopy and angiography:** Fluoroscopic imaging system, Digital fluoroscopy-c-arm system, Digital subtraction angiography (DSA), digital subtraction programming, angioplasty. | |
| **Infra red Imaging**: Physics of thermography, Infrared detectors, Imaging systems, clinical themography, liquid crystal thermography, modern application. | **5L** |

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|---|---|
| **Computed tomography:** Principles of computed tomography, Scanning system, Detectors, Processing / data acquisition system, viewing system, storing & documentation, gantry geometry, Different informations from gantry, CT numbers, image reconstruction techniques: back projection, iterative and analytical methods, image quality and artifacts, Dose in CT, Spiral CT. | **3L**<br><br>**9L** |
| **Total** | **34L** |

**Text Books:**

1. R. S. Khandpur "Handbook of Bio-Medical Instrumentation", 2nd Edition, Tata McGraw Hill.
2. J.J.Carr & J.M.Brown, "Introduction to Biomedical Equipment Technology" Pearson Education, Asia.
3. J.Webster, "Bioinstrumentation", Wiley & Sons

**References:**

1. Dowsett, Kenny & Johnston, "The Physics of Diagnostic Imaging", Chapman & Hall Medical, Madras/London.
2. Brown, Smallwood, Barber, Lawford & Hose, "Medical Physics and Biomedical Engineering", Institute of Physics Publishing, Bristol.
3. Massey & Meredith , "Fundamental Physics of Radiology", John Wright & Sons.
4. S. Webb, "The Physics of Medical Imaging", Ada m Hilger, Bristol.
5. Sybil M Stockley, "A Manual of Radiographic Equipments", Churchill Livingstones.
6. Chistrmis , "Physics of Diagnostic Radiology"

**Microprocessors & Microcontrollers**
**Code: BME-604A**
**Contact: 3L + 1T** **Credits: 4**

Introduction to Microcomputer based system. History of evolution of Microprocessor and Microcontrollers and their advantages and disadvantages. 1L
Architecture of 8085 Microprocessor. Address/data bus demultiplexeing, status Signals and the control signal generation. Instruction set of 8085 microprocessor, Classification of instruction, addressing modes, timing diagram of the instructions ( a few examples). 7L
Assembly language programming with examples, Interrupts of 8085 processor, programming using interrupts. 5L
Serial and parallel data transfer – programmed I/O, interrupts driven I/O, DMA, asynchronous and synchronous serial transmission using SID and SOD pins of 8085 processor. 2L
Introduction to MCS-51 microcontroller –Architecture, pin details, memory organization, Hardwar features of MCS-51, external memory interfacing, timers, interrupts, power management, serial port, addressing modes, assembly language programming. 5L
THE 8086 microprocessor- Architecture, pin details, addressing modes, instruction set, Assembly language programming interrupts. 3L
Support IC chips- 8255, 8253, 8259, 8279 and 8251 and their interfacing with 8085, 8086 and microcontroller 8051. 8L
Keyboard and Multiplexed display, LCD interfacing, with 8085, 8086, and 8051. 3L
Memory interfacing with 8085, 8086, and 8051- ADC and DAC interfacing with the processor 8085, 8086 and 8051. 2L
Brief introduction to PIC microcontroller (16F877) 1L

**Texts :**

1. Microprocessors and microcontrollers - N. Senthil Kumar, M. Saravanan and Jeevananthan (Oxford univ.press)
2. 8051 Microcontroller – K. Ayala (Cengage learning)
3. MICROPROCESSOR architecture, programming and Application with 8085 - R.Gaonkar (Penram international Publishing LTD. )
4. 8051 Microprocessor –V. Udayashankara and M.S Mallikarjunaswami (TMH).
5. Microprocessor 8085 and its Interfacing—S Mathur (PHI)
6. An Introduction to Microprocessor and Applications –Krishna Kant (Macmillan)

**Reference:**

1. 8086 Microprocessor –K Ayala (Cengage learning)
2. The 8085 Microprocessor,Architecture,Programming and Interfacing- K Uday Kumar,B .S Umashankar (Pearson)
3. The X-86 PC Assembly language, Design and Interfacing - Mazidi, Mazidi and Causey (PEARSON)
4. The 8051 microcontroller and Embedded systems - Mazidi, Mazidi and McKinley (PEARSON)
5. Microprocessors – The 8086/8088, 80186/80386/80486 and the Pentium family – N. B. Bahadure (PHI).
6. The 8051 microcontrollers – Uma Rao and Andhe Pallavi (PEARSON).

**Microelectronics & VLSI Designs [Same as ECE-702 or EE-604(c)]**
**BME-604B**
**Contracts: 3L + 1T** **Credits- 4**

**Electronic Measurement and Instrumentation**
Code: BME 605A
Contact: 3L Credit: 3

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|---|---|
| **Basic Measurement Concepts:** Measurement systems – Static and Dynamic Characteristics – Units and Standards of measurements, –errors analysis, –moving iron meters, dynamometer, wattmeter– multimeter, – True rms meters– Bridge measurements, Wheatstone Bridge, Kelvin, Wein, Maxwell, Hay, Schering and Anderson Bridges. | **6L** |
| **Basic Measurement Concepts:** Electronic Multimeter Current measurement with analog electronic instruments. Chopper stabilized amplifier for measurement of very low voltage and currents. Cathode Ray Oscilloscopes- Block Schematic, Principles and applications. Dual Trace and Dual Beam Oscilloscopes, Digital Storage Oscilloscopes | **7L** |
| **Signal Generator and Analysis:** Function Generators- RF Signal Generators- Sweep Generators – Frequency Synthesizer-Wave Analyzer-Harmonic Distortion Analyzer – Spectrum Analyzer | **7L** |
| **Digital Instruments:** Comparison of analog & digital techniques- digital voltmeter- mutlimeter – frequency counters-measurement of frequency and time interval – extension of frequency range- measurement errors. | **7L** |
| **Data Acquisition Systems:** Elements of digital data acquisition system- interfacing of transducers –multiplexing – computer controlled instrumentation : IEEE 488 Bos. Optical Power Measurement, Optical Time Domain Reflectometer. | **7L** |
| **Total** | **34L** |

**Books:**


1. Modern Electronic Instrumentation & Measurement Techniques – Albert D. Helfrick & William D. Copper,Prentice Hall of India, 2003
2. Elements of Electornics Instrumentation & Measurement, Pearson Education 2003
3. Measurement System- Application & Design – Ernest O.Doeblin, Tata McGraw Hill 2004


**Database Management System**
**BME-605B**
**Contact:** 3L Credits: 3

**Introduction [4L]**
Concept & Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS.

**Entity-Relationship Model [6L]**
Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features.

**Relational Model [5L]**
Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications Of the Database.

**SQL and Integrity Constraints [8L]**
Concept of DDL, DML, DCL. Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, assertions, views, Nested Subqueries, Database security application development using SQL, Stored procedures and triggers.

**Relational Database Design [9L]**
Functional Dependency, Different anamolies in designing a Database., Normalization using funtional dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Nomalization using multi-valued depedencies, 4NF, 5NF

**Internals of RDBMS [7L]**
Physical data structures, Query optimization : join algorithm, statistics and cost bas optimization. Transaction processing, Concurrency control and Recovery Management : transaction model properties, state serializability, lock base protocols, two phase locking.

**File Organization & Index Structures [6L]**
File & Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes, Dynamic Multilevel Indexes using B tree and B+ tree .

**Text Books:**


1. Henry F. Korth and Silberschatz Abraham, “Database System Concepts”, Mc.Graw Hill.
2. Elmasri Ramez and Novathe Shamkant, “Fundamentals of Database Systems”, Benjamin Cummings Publishing.
Company.
3. Ramakrishnan: Database Management System , McGraw-Hill
4. Gray Jim and Reuter Address, “Transaction Processing : Concepts and Techniques”, Moragan Kauffman Publishers.

5. Jain: Advanced Database Management System CyberTech
6. Date C. J., "Introduction to Database Management", Vol. I, II, III, Addison Wesley.
7. Ullman JD., "Principles of Database Systems", Galgottia Publication.

**Reference:**

1. James Martin, "Principles of Database Management Systems", 1985, Prentice Hall of India, New Delhi
2. "Fundamentals of Database Systems", Ramez Elmasri, Shamkant B.Navathe, Addison Wesley Publishing Edition
3. "Database Management Systems", Arun K.Majumdar, Pritimay Bhattacharya, Tata McGraw Hill

**Operating System**
**Code: BME-505C**
**Contact: 3L** **Credits: 3**

**Introduction [4L]**
Introduction to OS. Operating system functions, evaluation of O.S., Different types of O.S.: batch, multi-programmed, timesharing, real-time, distributed, parallel.
**System Structure[3L]**
Computer system operation, I/O structure, storage structure, storage hierarchy, different types of protections, operating system structure (simple, layered, virtual machine), O/S services, system calls.
**Process Management [17L]**
***Processes [3L]:*** Concept of processes, process scheduling, operations on processes, co-operating processes, interprocess communication.
***Threads [2L]:*** overview, benefits of threads, user and kernel threads.
***CPU scheduling [3L]:*** scheduling criteria, preemptive & non-preemptive scheduling, scheduling algorithms (FCFS, SJF, RR, priority), algorithm evaluation, multi-processor scheduling.
***Process Synchronization [5L]:*** background, critical section problem, critical region, synchronization hardware, classical problems of synchronization, semaphores.
***Deadlocks [4L]:*** system model, deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.
**Storage Management [19L]**
***Memory Management [5L]:*** background, logical vs. physical address space, swapping, contiguous memory allocation, paging, segmentation, segmentation with paging.
***Virtual Memory [3L]:*** background, demand paging, performance, page replacement, page replacement algorithms (FCFS, LRU), allocation of frames, thrashing.
***File Systems [4L]:*** file concept, access methods, directory structure, file system structure, allocation methods (contiguous, linked, indexed), free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency & performance.
***I/O Management [4L]:*** I/O hardware, polling, interrupts, DMA, application I/O interface (block and character devices, network devices, clocks and timers, blocking and nonblocking I/O), kernel I/O subsystem (scheduling, buffering, caching, spooling and device reservation, error handling), performance.
***Disk Management [3L]:*** disk structure, disk scheduling (FCFS, SSTF, SCAN,C-SCAN) , disk reliability, disk formatting, boot block, bad blocks.

**Protection & Security [4L]**
Goals of protection, domain of protection, security problem, authentication, one time password, program threats, system threats, threat monitoring, encryption.

***Text Books / References* :**

1. Milenkovie M., "Operating System : Concept & Design", McGraw Hill.
2. Tanenbaum A.S., "Operating System Design & Implementation", Practice Hall NJ.
3. Silbersehatz A. and Peterson J. L., "Operating System Concepts", Wiley.
4. Dhamdhere: Operating System TMH
5. Stalling, William, "Operating Systems", Maxwell McMillan International Editions, 1992.
6. Dietel H. N., "An Introduction to Operating Systems", Addison Wesley.

**Practical**

**Biomedical Instruments Lab**
Code: BME 691
Contacts: 3P Credits: 2

[Demonstration and /or study of working of the following biomedical instruments to understand the applications & technology involved in these instruments- using student training kits & simulator.]

**List of experiments:**

1. Pacemaker Circuits / Pacemaker simulator
2. Lead selection circuits
3. Study on simulated DC defibrillator
4. Study on muscle stimulator
5. Study on ultrasound diathermy unit

6. Study on X-ray radiography systems / X-ray simulator
7. Study on bio-telemetry system
8. Study on pulse rate meter
9. Study on Baby incubator / Infusion pump
10. Study on EMG biofeedback system

**Biomedical Digital Signal Processing Lab**
Code: BME 692
Contact: 3P Credit: 2

[The following experiments to be conducted using Matlab/C ]

**List of experiments:**

1. Find out DFT of a Step Sequence.
2. Power Spectral Density of any sequence.
3. Estimation of Power Spectral Density.
4. Frequency Response, Phase Response & Magnitude Response of all types of FIR filter.
5. Frequency Response, Phase Response & Magnitude Response of all types of IIR filter.
6. Auto-Correlation and Cross-Correlation of ECG signals.
7. Correlation of ECG Signal & Noise Signal.
8. Convolution of ECG Signal & Noise Signal.
9. DCT and IDCT of ECG signal.
10. FFT and IFFT of ECG signals
11. 60-Hz adaptive filter
12. Reduction of ECG signal

**Microprocessors & Microcontrollers Lab**
**Code: BME-694A**
**Contact: 3P Credits: 2**

| Sl. No. | Name of the Experiments | No. of hours |
|---|---|---|
| **1** | Study of prewritten programs on trainer kit using the basic instruction set (data transfer, Load/Store, Arithmetic, Logical) Assignments based on above. | **3** |
| **2** | a) Familiarization with 8085 & 8051simulator on PC.<br>Study of prewritten programs using basic instruction set (data transfer, Load/Store, Arithmetic, Logical) on the simulator. Assignments based on above | **3** |
| **3** | **Programming using kit and simulator for:**<br>i) Table look up<br>ii) Copying a block of memory<br>iii) Shifting a block of memory<br>iv) Packing and unpacking of BCD numbers<br>v) Addition of BCD numbers<br>vi) Binary to ASCII conversion<br>vii) String Matching, Multiplication using shift and add method and Booth's Algorithm | **6** |
| **4** | Program using subroutine calls and IN/OUT instructions using 8255 PPI on the trainer kit e.g. subroutine for delay, reading switch state and glowing LEDs accordingly. | **3** |
| **5** | **:Study of timing diagram of an instruction on oscilloscope..** | **3** |
| **6** | Interfacing of 8255**: Keyboard and Multi-digit Display with multiplexing using 8255** | **6** |
| **7** | Study of 8051 Micro controller kit and writing programs as mentioned in S/L3. Write programs to interface of Keyboard, DAC and ADC using the kit. | **3** |
| **8** | Serial communication between two trainer kits | **3** |

**Total 30 hours (10 classes each of 3 periods)**

**VLSI Design Lab [Same as EC-792]**
Code: BME 694B
Contacts: 3P Credits: 2

**Biomaterials & Tissue Engineering**
**Code: BME 701**
**Contacts: 3L** **Credits: 3**

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|---|---|
| **Characterization and Properties of Biomaterials:** Introduction to biomaterials, Basic criteria for biomaterials, classification of biomaterials, selection and performance of biomaterials, biological responses, mechanical properties-stress strain behaviour and hardness, mechanical failures, electrical properties and piezoelectricity, optical properties, surface and physical properties. | 7L |
| **Metallic & Ceramic Biomaterials:** Stainless steels, Co-Cr Alloys, Ti Alloys, Corrosion of metallic Implants. Non-absorbable materials: Alumina, Carbons, Zirconia. Biodegradable Ceramics: Calcium phosphate, Aluminum-Calcium-Phosphate (ALCAP) Ceramics. Bioactive ceramics: Glass ceramics, Hydroxyapatite. | 7L |
| **Polymeric & Composite Biomaterials:** Polymerization and basic structure, Polymeric biomaterials: Polyethylene (PE), Polypropylene (PP), Polyvinylchloride (PVC), Polyamide (Nylon), Polytetrafluoroethylene (PTFE), Plolymethylmetacrylate (PMMA), Polyetherether ketone (PEEK), Silicone rubber, Hydrogels, Biodegradable polymers. Various applications of polymers in medical field. Properties and types of composites. | 7L |
| **Biocompatibility & Sterilisation of biomaterials:** Introduction to biocompatibility, blood compatibility and tissue compatibility. Toxicity screening tests of biomaterials, Evaluation of systemic toxicity, haemolysis, cytotoxicity and special tests. Sterilization of implantable biomaterials, Effects of sterilization on material properties. | 5L |
| **Tissue Engineering:** Basic principles and strategies of tissue engineering, vascularisation and angiogenesis, Different cell types, progenitor cells and cell differentiations, Cell culture and storage, different kind of matrix (ECM), cell-cell interaction. Cell signaling molecules, growth factors, Cell surface markers, cell adhesion, receptor-ligand binding, Scaffold and engineering materials, 3-D architecture and cell incorporation, bioreactors, Tissue engineering applications, Inflammatory and Immunes responses to tissue engineered devices, Fundamental of Stem Cell tissue engineering. | 10L |
| **Total** | **36L** |

**Test books**


1. J B Park, *Biomaterials - Science and Engineering*, Plenum Press , 1984.
2. Sujata V. Bhat, *Biomaterials*, Narosa Publishing House, 2002.
3. Bronzino JD, ed. The Biomedical Engineering Handbook, Second Edition, Vol-II, CRC Press


**References**


1. Jonathan Black, *Biological Performance of materials*, Marcel Decker, 1981
2. C.P.Sharma & M.Szycher, *Blood compatible materials and devices*, Tech.Pub.Co. Ltd., 1991.
3. Piskin and A S Hoffmann, *Polymeric Biomaterials* (Eds), Martinus Nijhoff Publishers.
4. Eugene D. Goldbera , *Biomedical Ploymers*, Akio Nakajima.
5. L. Hench & E. C. Ethridge, *Biomaterials - An Interfacial approach*.
6. Buddy D.Ratner, Allan S. Hoffman, Biomaterial Sciences – Int. to Materials in Medicine
7. Frederick H. Silver, Biomaterials, Medical devices and Tissue Engineering, Chapman & Hall
8. Lanza RP, Langer R, Chick WL, eds, Principles of Tissue Engineering, RG Landes Co.


**Biomechanics & Implants**
**Code: BME 702**
**Contacts: 3L** **Credits: 3**

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|---|---|
| **Hard and Soft tissues mechanics:** Structure and composition of bone, mechanical properties of bones, anisotrophy, viscoelasticity, Maxwell and Voight models, Electrical properties of bone, type of fractures, biomechanics of fracture healing, piezo electricity and electrical stimulation for bone healing, External and internal fixation, Intramedullary nails, plates, screws, Structure and functions of cartilages, tendons and ligaments, pseudoelasticity, non-linear stress-strain relationship. | 10L |
| **Biomechanics of joints and Locomotion:** Types of human joints, kinetics and kinematics of joints, lubrication of joints, mechanics of joints: shoulder, elbow, hip, knee and spinal column. Human locomotion, gait analysis and goniometry, Ergonomics, Foot Pressure measurements – Pedobarograph, Force platform, mechanics of foot. Moment of inertia-limb. | 9L |
| **Bio-Fluid Mechanics:** Introduction, viscosity, Newtonian and Non-Newtonian fluids, laminar flow, Couette flow and Hagen-poiseuille equation, turbulent flow, Rheological properties of blood, effect of blood viscosity: shear rate, hematocrit, temperature, protein content and yield stress. Casson's equation. Flow properties of blood through the blood vessels. | 7L |
| **Implants and Prostheses:** General concepts of Implants, classification of implants, Soft tissues replacements and Hard tissue replacements, basic consideration and limitation of tissue replacement, body Response to Implants: Cellular & Systemic response. Prostheses: Total Hip Joint, Knee Joint, Shoulder Joint, Small Joints. Brief of Percutaneous and Skin implants, Ear and Eye Implants, dental implants. Cardiovascular implants: Prosthetic heart valves, biological and mechanical valves, Heterogrils, Homograils, testing of valves, Different heart valve prosthesis. | 10L |
| **Total** | **36L** |

**Text Books**


1. Alexander R Mc Neill, Biomechanics, Chapman and Hall, 1975
2. D.Dawson & V.Wright, Introduction to Biomechanics of joints and joint replacement
3. D N Ghista, Biomechanics of Medical Devices, Macel Dekker, 1982


**References**


1. D.O.Cooney, Biomedical Engineering Principles, Macel Dekker, INC, Newyork
2. A Z Tohen and C T Thomas, Manual of Mechanical Orthopaedics
2. D N Ghista and Roaf, Orthopaedic Mechanics, Academic Press
3. VC Mow and W C Hayes, Basic Orthopedic Biomechanics, Lippincott, Raven publishers.


**Medical Image Processing**

Code: BME 703A

Contact: 3L + IT Credit: 4

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|---|---|
| **Digital image fundamentals**: Image digitization, sampling and quantization, neighbour of pixels, connectivity, relations, equivalence and transitive closure, distance measures, arithmetic / logic operations, discrete transform, fast Fourier transform, 2-D Fourier transform, inverse Fourier transform. | **8L** |
| **Image enhancement fundamentals**: Spatial domain method, frequency domain method, contrast enhancement, histogram processing, image smoothing, image averaging, masking, image sharpening, removing of blur caused by uniform linear motion, enhancement in the frequency domain: low pass, high pass, mean and band-pass filtering, special examples using CT and MRI. | **10L** |

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| **Image restoration fundamentals**: Degradation model, discrete formulation, algebraic approach to restoration: unconstrained and constrained.<br><br>**Image compression and segmentation fundamentals**: Fidelity criteria, image compression models, lossy and lossless compression technique. Image segmentation: point detection, line detection, edge detection, edge linking and boundary detection, special examples using CT and MRI.<br><br>**Morphological Image Processing:** Definition of Morphological Imaging, Different Morphological Operator: Dilation, Erosion, Opening, Closing, Thickening, Thinning, Skeletons, Pruning. Hit-or-Miss Transfrom. | **4L**<br><br>**10L**<br><br>**8L** |
| **Total** | **40L** |

**Text books:**

1. Gonzalez and Woods, Digital image processing, 2nd ed., Pearson
2. Chanda & Majumdar, Digital image processing and analysis, PHI
3. Jain, Fundamental of digital image processing, PHI

**References**

1. Avinash.K, Digital Image Processing
2. William K.Pratt, Digital Image Processing, 3rd ed., John Wiley & Sons
3. Tou and Gonzalez, Pattern recognition

**Adaptive Signal Processing**

Code: BME 703B

Contact: 3L + IT Credit: 4

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|---|---|
| **Module-I**<br>**Introduction:** Adaptive Systems – Definition and characteristics, General properties, Open and Closed Loop Adaptations, Applications<br>**The Adaptive Linear Combiner**: Performance function, Gradient and Mean Square Error, Examples.<br>**Module -II**<br>**Theory of Adaptation with Stationary Signals:** Properties of the Quadratic Performance Surface, Significance of eigen values, eigen vectors, coorelation matrix.<br>**Searching the Proformance Surface:** A simple gradient search algorithm, Stability and Rate of convergence, the learning curve<br>**Gradient Estimation and its effects on Adoption:** The performance penalty, Variance of the gradient estimate, Misadjustment.<br><br>**Module-III**<br>**Adaptive Algorithms and Structures:** The LMS Algorithm, Convergence, learning Curve, Performanece analysis, Filtered X LMS algorithm,<br>**Applications:** Adaptive Modeling and System Identification using adaptive filter, Inverse Adaptive Modeling, Deconvolution, and equalization using adaptive filter, Adaptive Control Systems using Filtered X LMS Algorithm, Adaptive Noise Cancellation using Adaptive filter | **10L**<br><br>**14L**<br><br>**16L** |
| **Total** | **40L** |

**Text Books :**

1. Bernard Widrow and Samuel D. Stearns, *Adaptive Signal Processing*, Pearson Education, 2nd impression 2009.

**Reference Book:**

2. Simon Haykin, *Adaptive Filter Theory*, 4th Edn., Pearson Education


**Advanced Medical Imaging Techniques**
Code: BME 704A
Contact: 3L Credit: 3

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|---|---|
| **Ultra Sound Imaging System:** Physics and production of ultrasound, Medical ultrasound, acoustic impedance, absorption and attenuation of ultrasound energy, pulse geometry, ultrasonic field, ultrasonic transducers and probe design, principles of image formation, image processing, display system: A-mode, B-mode and M-mode. Real-time ultrasonic imaging systems, electronic scanners, image artifacts, Doppler ultra sound and Colour velocity mapping, duplex ultrasound, bio-effects and safety levels. | **10L** |
| **Magnetic Resonance Imaging System:** Principles of nuclear magnetism, RF magnetic field and resonance, magnetic resonance (MR) signal, nuclear spin relaxations, gradient pulse, slice selection, phase encoding, frequency encoding, spin echoes, gradient echoes, K-space data acquisition and image reconstruction. MRI scanner hardware: magnet, gradient coil, RF pulse transmission and RF signal reception. Diagnostic utility and clinical MRI, functional MRI, magnetic resonance angiography (MRA), magnetic resonance spectroscopy (MRS), diffusion MRI, bio-effects and safety levels. | **14L** |
| **Nuclear Medical Imaging System:** Radio nuclides for imaging, nuclear decay and energy emissions, brief of radionuclide production and detectors, pulse height analyzer, uptake monitoring equipments, Rectilinear scanners, Gamma Camera, Single-photon Emission Computed Tomography(SPECT), Positron Emission Tomography(PET). | |
| **Clinical Applications:** Clinical aspects of PET/CT and SPECT/CT, cone beam CT for radiotherapy, perfusion CT, spiral CT, multi-slice CT, functional brain imaging, bone marrow scanning, CSF imaging, Thyroid and parathyroid imaging, Liver and spleen imaging. | **6L** |
| | **6L** |
| **Total** | **36L** |

**Text Books:**


4. Carr & Brown, “Introduction to Biomedical Equipment Technology” Pearson Education, Asia.
5. R. S. Khandpur, “Handbook of Bio-Medical Instrumentation”, Tata McGraw Hill.
6. J.Webster, “Bioinstrumentation”, Wiley & Sons


**References:**


7. Dowsett, Kenny & Johnston, “The Physics of Diagnostic Imaging”, Chapman & Hall Medical, Madras/London.
8. Brown, Smallwood, Barber, Lawford & Hose, “Medical Physics and Biomedical Engineering”, Institute of Physics Publishing, Bristol.
9. Massey & Meredith , “Fundamental Physics of Radiology”, John Wright & Sons.
10. S. Webb, “The Physics of Medical Imaging”, Ada m Hilger, Bristol.
11. Sybil M Stockley, “A Manual of Radiographic Equipments”, Churchill Livingstones.
12. Chistrmis , “Physics of Diagnostic Radiology”


**Virtual Instrumentation**
Code: BME 704B
Contact: 3L Credit: 3

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|---|---|
| **Review of Virtual Instrumentation:** Historical perspectives, Need of VI, advantages, Define VI, block diagram and architecture of a | **6L** |

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| virtual instrument, data -flow techniques, graphical programming in data flow, comparison with conventional programming.<br><br>**VI Programming Techniques:** VIS and sub-VIS loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O, Graphical programming in data flow, comparison with conventional programming.<br><br>**Data Acquisition Basics:** ADC, DAC, DIO, Counters & timers, PC Hardware structure, timing, interrupts, DMA, Software and Hardware Installation. GPIB/IEEE 488 concepts, and embedded system buses - PCI, EISA, CPCI, and USB & VXI. A<br><br>**Common Instrument Interfaces:**Current loop, RS.232C/RS.485, GPIB, System buses, interface buses: USB, PCMCIA, VXI, SCXI, PXI, etc., networking basics for office &.Industrial applications, Visa and lVI, image acquisition and processing. Motion control. ADC, DAC, DIO, DMM, waveform generator.<br><br>**Use of Analysis Tools:** Fourier transforms, power spectrum correlation methods, windowing & filtering, Major equipments- Oscilloscope, Digital Multimeter, Pentium Computers, Application in Biomedical field. | **8L**<br><br>**8L**<br><br>**8L**<br><br>**6L** |
| **Total** | **36L** |

**Text Books:**

1. Gary Jonson, Labview Graphical Programming, 2nd ed., McGraw Hill, New York, 1997
2. Lisa K. wells & Jeffrey Travis, Labview for everyone, Prentice Hall Inc., NJ; 1997

**Reference Books:**

1. Sokoloff; Basic concepts of Labview 4, Prentice Hall Inc., New Jersey 1998
2. S. Gupta, J.P: Gu.pta, PC interfacing for Data Acquisition & Process Control, Second Edition, Instrument Society of America, 1994
3. Technical Manuals for DAS Modules of Advantech and National Instruments
4. L.T. Amy, Automation System for Control and Data Acquisition , ISA, 1992

**Power & Control System**

Code: BME 705A

Contact: 3L + IT Credit: 4

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|---|---|
| **Thyristor:** Introduction, Thyristor family, Principles of operations of SCR, Two transistor model of SCR, Gate characteristics, Turn on & off methods of Thyristor, Firing of Thyristor, Gate trigger circuits. Brief of modern power semiconductor devices: DIAC, TRIAC, GTO, RCT, SIT, LASCR, IGBT, MOSFET, UJT.<br><br>**Phase Control Rectifiers and Inverters:** Introduction, Phase angle control, 1-Phase half & full wave control rectifier, 3-Phase half & full controlled bridge converter, Thyristor Inverter classification: Series Inverters, Parallel Inverters, 1-Phase & 3-Phase bridge inverters.<br><br>**Choppers and AC Regulators:** Principle of operation, Step up/down chopper, Chopper Configuration, AC Chopper, 1-Phase & 3- phase AC Regulator.<br><br>**Feedback Characteristics:** Open and closed loop, Mathematical models of physical systems, Transfer function, Block diagram algebra, Signal flow graphs, Feed back & non feed back systems, Regenerative feedback.<br><br>**Control system components**: Error sensing devices, potentiometer, tachometer, servomotors, stepper motor, Hydraulic system, Pneumatic System, P, PI and PID controller.<br><br>**Time Domain and Frequency Domain Analysis:** Introduction, Time response to 1st order & 2nd order systems, Effect of adding pole zeros to TF, R-H criteria, Root Locus method, Frequency response plot: Polar Plots, Bode Plots, Nyquist Criteria. | **10L**<br><br>**8L**<br><br>**6L**<br><br>**4L**<br><br>**6L**<br><br>**6L** |


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| **Total** | **40L** |

**Text/ Reference books:**

1. Power Electronics – MD Singh & KB Khanchandani, Tata Mackgrow Hill
2. Power Electronics – Mohan, Undeland & Robbins – John Willey & Sons
3. Power Electronics – Vedam Subhramanyam – New Age International
4. Modern Power Electronics – B.K. Bose – Jacio Publishing House
5. Modern Power Electronics – P.C. Sen – Wheeler Publishing
6. Power Electronics – B.R. Gupta – S.K. Kataria & Sons.
7. Modern Control Engineering – K. Ogata – P H I
8. Automatic Control Systems – Kuo – P H I
9. Control Systems Engineering – I.J. Nagnath & Gopal – New Age

**Biological Control System & Modelling**

Code: BME 705B

Contact: 3L + IT Credit: 4

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|---|---|
| **Introduction**: Technological control system, transfer function, mathematical approaches, system stability, similarities between biological and engineering control system, technique of mathematical modelling, importance of physiological modelling and signal analysis, linearization of nonlinear models, Time invariant and time varying systems for physiological modelling. | **10L** |
| **Process regulation**: Acid-base balance, extra-cellular water and electrolyte, interstitial fluid volume, blood pressure, blood glucose, $CO_2$, thermal regulatory system. | **6L** |
| **Biological control:** Cardiac rate, blood pressure, respiratory rate, mass balancing of lungs, oxygen uptake by RBC and pulmonary capillaries, oxygen and carbon dioxide transport in blood and tissues, urine formation and control, Pupil control systems, skeletal muscle servomechanism, and semicircular canal. Free swinging limbs, Endocrine control system. | **10L** |
| **Physiological modelling**: Hodgkin and Huxley's model of action potential, Huxley model of isotonic muscle contraction, modeling of EMG, modeling of ECG Electrical analog of blood vessels, model of systematic blood flow, model of coronary circulation, transfer of solutes between physiological compartments by fluid flow, counter current model of urine formation, model of Henle's loop and Linearized model of the immune response. | **14L** |
| **Total** | **40L** |

**Text / Reference Books:**

1. Ogata Katsuhika, Mondern control engineering. 2nd edition, Prentice Hall of India.
2. Ibrell and Guyton, Regulation and control in physiological system,
3. Milsum John H., Biological control systems analysis, Tata McGraw-Hill.
4. Milhorn T.H. Saunder. Application of control theory to physiological systems,
5. Suresh.R.Devasahayam, Signals & Systems in Biomedical Engineering, Kluwer Academic/ Plenum Publishers.
6. V.Z. Marmarelis, Advanced methods of physiological modeling, Plenum Press.
7. J. Candy, Signal Processing: The Model Based approach, Mc. Graw Hill.
8. Endarle, Blanchard & Bronzino, Introduction to Biomedical Engg. , Academic press.

**Artificial Intelligence & Pattern Recognition**

Code: BME 705C

Contact: 3L + IT Credit: 4

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|---|---|
| **NTRODUCTION TO AI**: Definition of Artificial Intelligence, History and Applications, Components of AI Structures and Strategies for state space search- Data driven and goal driven search , Depth First and Breadth First Search, DFS with Iterative Deepening ,Heuristic Search- Best First Search, A* Algorithm, Constraint Satisfaction. | **6L** |
| **KNOWLEDGE REPRESENTATION IN AI:** Knowledge representation - Propositional calculus, Predicate Calculus, Theorem proving by Resolution, Answer Extraction, AI Representational Schemes- Semantic Nets, Conceptual Dependency, Scripts, Frames. | **8L** |
| **PATTERN RECOGNITION CONCEPTS:** Introduction to statistical, syntactic and descriptive approaches, features and feature extraction, learning; Bayes Decision theory- introduction, continuous case, 2-categoryclassification, minimum error rate classification, classifiers, discriminant functions, and decision surfaces. Error probabilities and integrals, normal density, discriminant functions for normal density, Bayes Decision theory Discrete case. | **10L** |
| **LINEAR DISCRIMINANT FUNCTIONS:** Linear discriminant functions- linear discriminant functions and decision surfaces, generalized linear discriminant functions, 2-category linearly separable case, non-separable behavior, linear programming procedures. | |
| **SUPERVISED LEARNING AND CLUSTERING:** Supervised learning and clustering- Mixture densities and identifiably, Maximum likelihood estimates, application to normal mixtures, unsupervised Bayesian learning, data description and clustering, Hierarchical clustering, low dimensional representation of multidimensional map. | **8L** |
| | **8L** |
| **Total** | **40L** |


TEXT BOOKS

1. GEORGE.F.LUGER, *Artificial Intelligence- Structures and Strategies for Complex* Problem Solving, 4/e, 2002, Pearson Education
2. Duda and Hart P.E, *Pattern classification and scene analysis*, John wiley and sons, NY, 1973

REFERENCE BOOKS

1. Earl Gose, Richard Johnsonbaugh, and Steve Jost; *Pattern Recognition and Image Analysis*, PHI Pvte. Ltd., NewDelhi-1, 1999
2. Fu K.S., *Syntactic Pattern recognition and applications*, Prentice Hall, Eaglewood cliffs, N.J., 1982
3. Rochard O. Duda and Hart P.E, and david G Stork, *Pattern classification*, 2 nd Edn., John Wiley & Sons Inc., 2001


**Group Discussion & Seminar**
Code: HU 791
Contacts: 3P Credits: 2

**Biomaterials & Biomechanics Lab**
Code: BME 791
Contacts: 3P Credits: 2

**List of Experiments**:

1. Mechanical characterization of metallic biomaterials
2. Mechanical characterization of polymeric biomaterials
3. Hardness testing of biomaterials
4. Surface roughness measurement of biomaterials
5. Estimation of haemocompatibility of biomaterials by hemolysis studies
6. Measurement of torque required to tap and screwing in jaw bone.
7. Determination of moment of inertia of human limb using dynamometer.
8. Determination of moment of inertia of human bone using compound pendulum method.
9. Stress-strain analysis of hip prosthesis
10. Ultrasonic characterization of biomaterials-NDE

**Biomedical Instruments & System Lab**
Code: BME 792
Contacts: 3P Credits: 2

**List of experiments:**

1. Study on ECG heart rate monitor with alarm system
2. Study on peripheral pulse rate monitor with alarm system
3. Study on digital body/skin temperature monitoring system
4. Spectral analysis of biopotentials - Physiograph
5. Study on multi-parameter monitor
6. Study on cardiac stress analysis
7. Study on US Doppler / Foetal monitor
8. Study on hearing aid and audiometer: air and bone conduction
9. Study on nerve conduction velocity measuring system
10. Study on ECG simulator and servicing of ECG machine

**Medical Image Processing Lab**
Code: BME 793A
Contacts: 3P Credits: 2

**List of experiments:**
**[Students are required to perform at least EIGHT experiments]**

1. Image enhancement – Histogram
2. Image smoothing
3. Image sharpening
4. Point detection
5. Line detection
6. Edge detection
7. Image data compression
8. Image Characterization
9. Vector & Matrix Indexing
10. Fourier Transform
11. Image Transformation
12. Morphological Image Processing

**Adaptive Signal Processing Lab**
Code: BME 793B
Contacts: 3P Credits: 2

**List of experiments:**

1. Familiarization with the architecture of a standard DSP kit (Preferably TMS 320C6XXX DSP kit of Texas Instruments)
2. Generation of various types of waveforms (sine, cosine, square, triangular etc.) using MATLAB and DSP kit.
3. Linear convolution of sequences (without using the inbuilt conv. function in MATLAB) and verification of linear convolution using DSP kit.
4. Circular convolution of two sequences and comparison of the result with the result obtained from linear convolution using MATLAB and DSP kit.
5. (i) Computation of autocorrelation of a sequence, cross correlation of two sequences using MATLAB.
(ii) Computation of the power spectral density of a sequence using MATLAB also implementing the same in a DSP kit.
6. Finding the convolution of a periodic sequence using DFT and IDFT in MATLAB.
7. (i) Implementation of FFT algorithm by decimation in time and decimation in frequency using MATLAB.
(ii) Finding the FFT of a given 1-D signal using DSP kit and plotting the same.
8. Design and implementation of FIR (lowpass and highpass) Filters using windowing techniques (rectangular window, triangular window and Kaiser window) in MATLAB and DSP kit.
9. Design and implementation of IIR (lowpass and highpass) Filters (Butterworth and Chebyshev) in MATLAB and DSP kit.
10. (i) Convolution of long duration sequences using overlap add, overlap XXXXX using MATLAB.
(ii) Implementation of noise cancellation using adaptive filters on a DSP kit.

**Reference Books:**

1. Digital Signal Processing: A MATLAB-Based Approach – Vinay K. Ingle and John G. Proakis, Cengage Learning.
2. Fundamentals of Digital Signal Processing using MATLAB – Robert J. Schilling and Sandra L. Harris, Cengage Learning.

**Organizational Behaviour**
Code: HU 801A
Contact: 2L Credit: 2

| | |
|---|---|
| **Organizational Behaviour:** Definition, Importance, Historical Background, Fundamental Concepts of OB,Challenges and Opportunities for OB. | **2L** |
| **Personality and Attitudes:** Meaning of personality, Personality Determinants and Traits, Development of Personality, Types of Attitudes, Job Satisfaction. | **2L** |
| **Perception:** Definition, Nature and Importance, Factors influencing Perception, Perceptual Selectivity, Link between Perception and Decision Making. | **2L** |
| **Motivation:** Definition, Theories of Motivation - Maslow's Hierarchy of Needs Theory, McGregor's Theory X & Y, Herzberg's Motivation-Hygiene Theory, Alderfer's ERG Theory, McClelland's Theory of Needs, Vroom's Expectancy Theory. | **4L** |
| **Group Behaviour:** Characteristics of Group, Types of Groups, Stages of Group Development, Group Decision Making. | |
| **Communication:** Communication Process, Direction of Communication, Barriers to Effective Communication. | **2L** |
| **Leadership:** Definition, Importance, Theories of Leadership Styles. | |
| **Organizational Politics:** Definition, Factors contributing to Political Behaviour. | **2L** |
| **Conflict Management:** Traditional vis-a-vis Modern View of Conflict, Functional and Dysfunctional Conflict,Conflict Process, Negotiation – Bargaining Strategies, Negotiation Process. | **2L** |
| **Organizational Design:** Various Organizational Structures and their Effects on Human Behaviour, Concepts of Organizational Climate and Organizational Culture. | **2L** |
| | **2L** |
| | **4L** |
| **Total** | **24L** |

**References:**


1. Robbins, S. P. & Judge, T.A.: Organizational Behavior, Pearson Education, 15th Edn.
2. Luthans, Fred: Organizational Behavior, McGraw Hill, 12th Edn.
3. Shukla, Madhukar: Understanding Organizations – Organizational Theory & Practice in India, PHI
4. Fincham, R. & Rhodes, P.: Principles of Organizational Behaviour, OUP, 4th Edn.
5. Hersey, P., Blanchard, K.H., Johnson, D.E.- Management of Organizational Behavior Leading Human Resources,PHI, 10th Edn


**Artificial Organs & Rehabilitation Engineering**
Code: BME 801A
Contact: 3L + IT Credit: 4

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|---|---|
| **Introduction to artificial organs:** Need of artificial organs, design consideration and evaluation process. artificial heart and engineering design, circulatory assist devices-IABP and SSI, cardiac catheterization, stents, CVP and SWAN catheters, blood substitutes and haemo dilution, oxygen carrying and hemoglobin based artificial blood, liver support system, artificial pancreas, artificial skin. | **8L** |
| **Artificial kidney:** Brief of kidney filtration, basic methods of artificial waste removal, hemodialysis, equation for artificial kidney and middle molecule hypothesis, artificial kidney machine, hemodialysers: flat plate type, coil type and hollow fiber. Mass transfer in dialyers, regeneration of dialysate, membrane configuration, portable and implantable artificial kidney machine, electrical safety and maintenance. | **8L** |
| **Artificial heart-lung machine:** Brief of lungs gaseous exchange / transport, artificial heart-lung devices, oxygenators: bubble, film oxygenators and membrane oxygenators. Gas flow rate and area for membrane oxygenators. | |
| **Rehabilitation Engineering:** Impairments, disabilities and handicaps, measurement and assessment. Engineering concepts in sensory and motor rehabilitation. Rehabs for locomotion, visual and speech. Spinal rehabilitation, ultrasonic binaural sensing aid for the blind, rehabilitation in sports. | **4L** |

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|---|---|
| **Orthotic and Prosthetic devices:** Artificial limb and hands, intelligent prosthetics, externally powered and controlled orthotics and prosthetics, FES system-restoration of standing and walking, hybrid assistive system, Myoelectric hand and arm prostheses, The MARCUS intelligent hand prostheses. | **6L** |
| **Hearing and mobility Aids:** Engineering concept in communication disorders. Common tests – audiograms, air conduction, bone conduction, masking techniques. Hearing aids – Principles, types, drawbacks in the conventional unit, DSP based hearing aids. Mobility aids-crutches, wheelchairs, Laser cane, ultrasound torch and guide. | **8L** |
| | **6L** |
| **Total** | **40L** |

**Text / Reference Books:**


1. Bronzino. Joseph, Hand book of biomedical engineering.
2. R.S.Khandpur, Hand book of biomedical instrumentation.
3. Erie.D.Blom, Howard.B.Rotham , Artificial Organs.
4. David O. Cooney, Biomedical Engineering Principles (Vol.-II), Marcel Dekker Inc.
5. Robbinson C.J., Rehabilitation Engineering. CRC press 1995
6. Ballabio E.etal, Rehabilitation Engineering. IOS press 1993.
7. Dr. S.Sundar, Rehabilitation Medicine. Jaypee Medical Pub., New Delhi.
8. Kopff W.J, Artificial Organs, John Wiley and sons, New York, 1976 (Unit II).


**LASERS and Fiber Optics in medicine**

Code: BME 801B

Contact: 3L Credit: 3

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|---|---|
| **LASER Fundamentals:** Characteristics of lasers, spontaneous and stimulated emission of radiation, Einstein's co-efficients, Population Inversion, Three level and four level lasers, Properties of laser,Laser modes, Resonator configuration, Cavity damping, Types of lasers: Gas lasers, solid lasers, liquid lasers, semiconductor lasers. | **8L** |
| **Lasers in surgery**: Surgical instrumentation of $CO_2$, Ruby, Nd-YAG, He-Ne, Argon ion, Q-switched operations, continuous wave, Quasi-continuous, surgical applications: removal of tumours of vocal cards ,brain surgery, plastic surgery, gynaecology and oncology. | **8L** |
| **Laser application**s: Lasers in tissue welding, lasers in dermatology, lasers in ophthalmology, laser photocoagulations, laser in dentistry, Laser flow cytometry, Laser transillumination & diaphanography, Speckle intereferometry, holography - Application Safety with biomedical Lasers. | **8L** |
| **Optical Fibres Fundamentals:** Principles of light propagation through a fibre, Different types of fibres and their properties, fibre characteristic, transmission of signal in SI and GI fibres, attenuation in optical fibres, Connectors and splicers, Fibre termination, Optical sources, Optical detectors. | **8L** |
| **Optical Fibre bundles and Applications:** Introduction and construction details of optical fibres, non-ordered fiber optic bundles for light guides-fundamentals & principles, ordered fiberoptic bundles for imaging devices-fundamentals & principles, fiberscopes and endoscopes-fundamentals, fiber optic imaging systems-advances, optical fiber in communication. | **8L** |
| **Total** | **40L** |

**Test Books:**


1. Leon Goldman, " The Biomedical laser Technology and Clinical Applications " Springer-Verlar
2. Leon Goldman, " Lasers in Medicine", Springer-Verlac
3. Pratesi E.D.R, and Sacchi, "Lasers in photomedicine and photo biology", Springer-Verlay
4. Basht M.L.Wel, "Laser applications in medicine and biology", Vol I,II,III, Plenum Press (1971 & 1974).
5. Nandini K. Jog, "Electronics in medicine and biomedical instrumentation", PHI
6. Wilson J. U Hawkes J.F.B., Opto Electronics: An Introduction, Prentice Hall Int. 1983
7. Allen H.C, An Introduction to optical fibers, Mc Graw Hill, New York, 1983.


**Health Technology Management**

# Syllabus for B.Tech (Bio Medical Engineering) up to Fourth Year

Revised Syllabus of B.Tech in BME for the students who were admitted in Academic Session 2010-2011)

Code: BME 802A
Contact: 3L + IT Credit: 4

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|---|---|
| **Healthcare System:** Health organization of the country, health technology and challenges in maintaining normal health, management of Indian Hospitals- challenges and strategies, modern techniques of hospital management. | **2L** |
| **Hospital Organization:** Classification of hospitals, role of hospital in healthcare, location and environment of hospital, wards, intensive care units, admitting department, medical record department, centralized sterilization and supply department, pharmacy, food services, laundry and linen services, house-keeping, evaluation of hospital services. | **8L** |
| **Planning and Designing of Medical Services:** Outpatient service, inpatient service, emergency service, clinical laboratories, radiology services, radiation therapy department, surgical department, critical care department, nursing department, operation theatre, CSSD, nursing services, blood banks. | **6L** |
| **Planning and Designing of Engineering Services:** Engineering department, Maintenance department, clinical (biomedical) engineering, preventive maintenance of equipments, electrical system, power supply system, air condition system, water supply and sanitary system, centralized gas supply system, telecommunication system, environmental control, safety and security system, fire safety and threat alarm system, hospital waste disposal system. | **12L** |
| **Hospital Management and Information System:** Role of HMIS, functional areas, modules forming HMIS, HMIS and internet, PACS, radiology information system, health information system, centralized data record system, computerized patient records, computer assisted patient education and healthcare information, material management, disaster management. | |
| **Regulation and Planning of New Hospital:** FDA regulation, accreditation for hospitals, ISO certification, fire protection standard, IRPC, planning and design of new hospital, guiding principle, facilities & services, function plans for hospital construction. | **8L** |
| | **4L** |
| **Total** | **40L** |

**Text / Reference Books:**


1. Cesar A. Caceres and Albert Zara, *The practice of Clinical Engineering*, Academic Press, 1977
2. Webster, J.G. and Albert M. Cook, *Clinical Engineering Principles and Practices*, Prentice Hall Inc. Englewood Cliffs, 1979
3. Antony Kelly, *Maintenance planning and control*, Butterworths London, 1984
4. Hans Pfeiff, Vera Dammann (Ed.) *Hospital Engineering in Developing Countries*, Z report Eschborn, 1986
5. Jacob Kline, *Handbook of Bio Medical Engineering*, Academic Press, San Diego 1988
6. R.C. Goyal, *Handbook of Hospital Personal Management*, Prentice Hall of India, 1993


**Medical informatics**

Code: BME 802B
Contact: 3L Credit: 3

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|---|---|
| **Introduction:** Structure of Medical Informatics, Internet and Medicine, Security issues, Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, e-health services, Health Informatics, Medical Informatics, Bioinformatics | **8L** |
| **Computerized Patient Record:** History taking by computer, Dialogue with the computer, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology, Application server provider, Clinical information system, Computerized prescriptions for patients. | **8L** |
| **Computers in Clinical Laboratory and Medical Imagining:** Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System, Computerized ECG, EEG and EMG, Computer assisted medical imaging- nuclear medicine, ultrasound imaging ultrasonography-computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance | **8L** |
| **Computer Assisted Medical Decision-Making :** Neuro-computers and Artificial Neural Networks application, Expert system, General model of CMD, Computer-assisted decision support system, production rule, system cognitive model, semester networks , decisions analysis in clinical medicine, computers in the care of critically patients, computer assisted surgery, designing. | **8L** |
| **Recent Trends in Medical Informatics:** Virtual reality applications in medicine, Computer assisted surgery , Surgical simulation, Telemedicine, Tele surgery computer aids for the handicapped, computer assisted instrumentation in Medical Informatics, Computer assisted patient education and health, Medical education and health care information. | |

| | |
|---|---|
| | **8L** |
| **Total** | **40L** |

Text /Reference Books:

1. R.D.Lele Computers in medicine progress in medical informatics, Tata Mcgraw Hill Publishing computers Ltd,2005, New Delhi
2. Mohan Bansal, Medicl informatics Tata Mcgraw Hill Publishing computers Ltd,2003 New Delhi

**Neural Network and Fuzzy Logic Control**
BME 802C
Contracts: 3L Credits: 3

| | |
|---|---|
| **Introduction neural network:** Advent of Modern Neuroscience, Neural Networks, Biological Neurons and Artificial neural network; model of artificial neuron, MLP, back propagation, Hopfield networks, Kohenen self organizing maps, adaptive resonance. | **8L** |
| **Neural network for control:** Schemes of neuro-control, identification and control of dynamical system, Neural controller for a temperature process. | **8L** |
| **Introduction to Fuzzy logic:** Fuzzy sets, Fuzzy relations, Fuzzy conditional statements, Fuzzy rules, Fuzzy algorithm, functional diagram. | **8L** |
| **Fuzzy logic control systems:** Fuzzy logic control, Fuzzification, defuzzification, knowledge base, decision making logic, design of Fuzzy logic controller, case study. | **8L** |
| **Neuro-Fuzzy logic control:** Adaptive fuzzy systems, optimization of membership function and rule base of fuzzy logic controller using neural networks, fuzzy neuron, case study. | **8L** |
| **Total** | **40L** |

**Text / Reference Books:**

1. Timothy J.Ross, *Fuzzy logic with Engineering Applications*, McGraw Hill, New york, 1996.
2. Kosko.B, *Neural Network and fuzzy systems*- o\prentice Hall of India Pvt. Ltd., New Delhi, 1992.
3. Klir G.J. and Folger T.A, Fuzzy sets, Uncertainty and Information, PHI
4. Simon Hayking, Neural network, ISA, Research Triangle Parke, 1995.
5. Kosco B., Neural networks and fuzzy systems: A dynamic approach to machine Intelligence, Prentice Hall USA, 1992.
6. Hertz J., Korgh A. and Palmer R.G., Introduction to the theory of neural computation. Addition-Wesley publishing co,, California, 1991.
7. Nie and Linkers: Fuzzy neural control: principles, alogorithms, and applications, PHI, 1998.