CURRICULUM

OF

BIO-MEDICAL ENGINEERING

BE/BS
&
ME/MS

2012

HIGHER EDUCATION COMMISSION
ISLAMABAD.

CURRICULUM DIVISION, HEC

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PREFACE

The curriculum of subject is described as a throbbing pulse of a nation. By viewing curriculum one can judge the stage of development and its pace of socio-economic development of a nation. With the advent of new technology, the world has turned into a global village. In view of tremendous research taking place world over new ideas and information pours in like of a stream of fresh water, making it imperative to update the curricula after regular intervals, for introducing latest development and innovation in the relevant field of knowledge.

In exercise of the powers conferred under Section 3 Sub-Section 2 (ii) of Act of Parliament No. X of 1976 titled **"Supervision of Curricula and Textbooks and Maintenance of Standard of Education"** the erstwhile University Grants Commission was designated as competent authority to develop, review and revise curricula beyond Class-XII. With the repeal of UGC Act, the same function was assigned to the Higher Education Commission under its Ordinance of 2002, Section 10, Sub-Section 1 (v).

In compliance with the above provisions, the HEC undertakes revamping and refurbishing of curricula after regular intervals in a democratic manner involving universities/DAIs, research and development institutions and local Chamber of Commerce and Industry. The intellectual inputs by expatriate Pakistanis working in universities and R&D institutions of technically advanced countries are also invited to contribute and their views are incorporated where considered appropriate by the National Curriculum Revision Committee (NCRC).

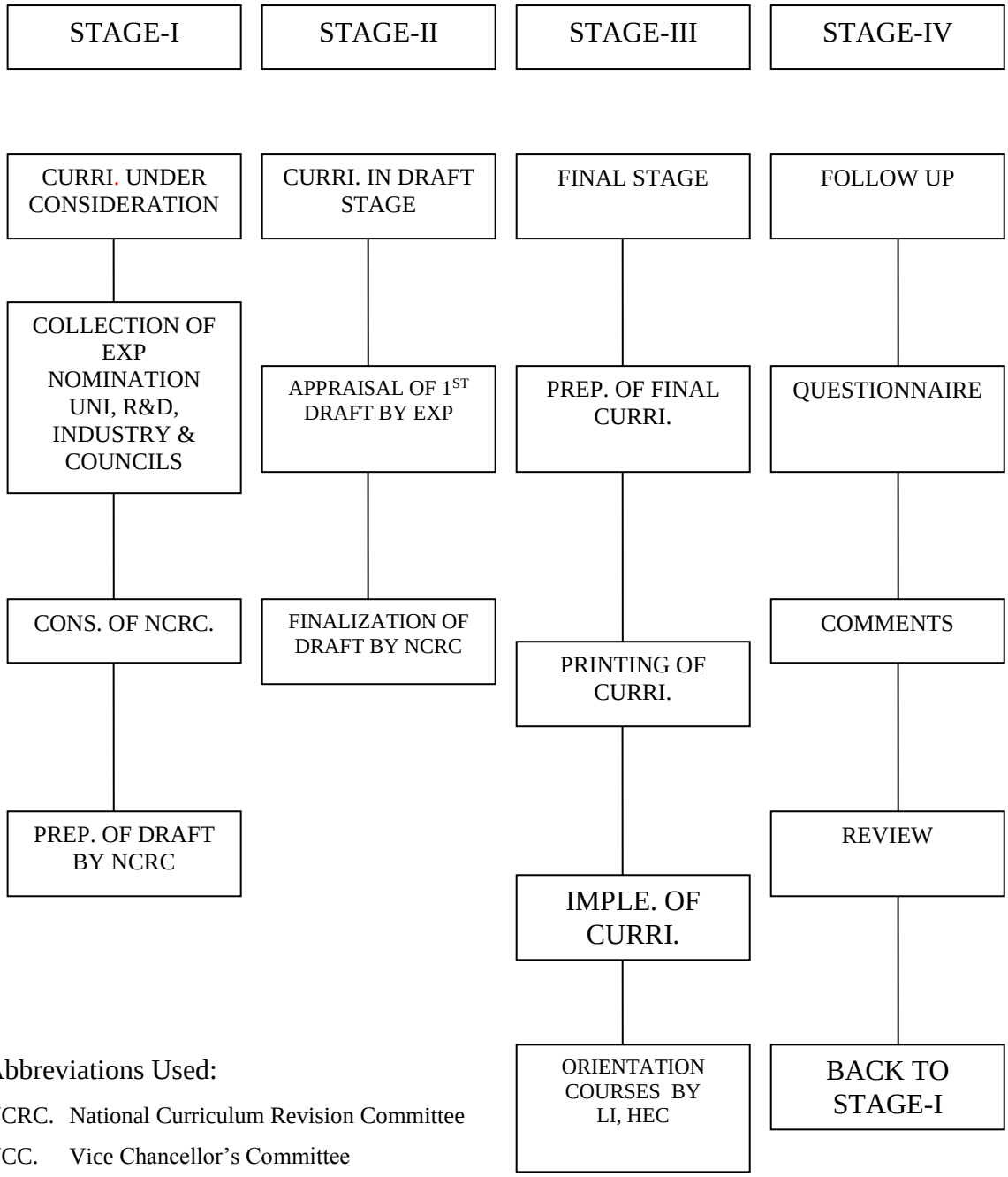
A committee of experts comprising of conveners from the National Curriculum Revision Committees of HEC in the disciplines of Basic, Applied, Social Sciences, Agriculture and Engineering met in 2007 & 2009 and developed the unified templates to standardize degree programmes in the country so as to bring the national curriculum at par with international standards, and to fulfill the national needs. It also aimed to give a basic, broad based knowledge to the students to ensure the quality of education.

In line with above, NCRC comprising senior university faculty and experts from various stakeholders and the respective accreditation councils has finalized the curriculum for Bio-Medical Engineering. The same is being recommended for adoption by the universities/DAIs channelizing through relevant statutory bodies of the universities.

MUHAMMAD JAVED KHAN
Adviser (Academics)

April, 2012

CURRICULUM DEVELOPMENT



Abbreviations Used:

NCRC.	National Curriculum Revision Committee
VCC.	Vice Chancellor's Committee
EXP.	Experts
COL.	Colleges
UNI.	Universities
PREP.	Preparation
REC.	Recommendations
LI	Learning Innovation
R&D	Research & Development Organization
HEC	Higher Education Commission

ittee (NCRC) final meeting was held
r Education Commission, Regional
urriculum in Bio-Medical Engineering
ember 2011. Following attended the

1. Prof. Dr. M. A. Haleem — Convener
   Professor / Chairman,
   Department of Bio-Medical Engineering,

Sir Syed University of Engineering and Technology, University Road, Karachi

2. Prof. Dr. Mirza Muhammad Javed — Secretary
Dean,
Faculty of Engineering and Applied Sciences,
Riphah International University,
I-14, Hajj Complex, Islamabad.

3. Engr. Prof. Dr. Bhawani Shankar Chaudhry — Member
Dean, Faculty of Electrical, Electronics, Bio-Medical and Computer Engineering.
Mehran University of Engineering & Technology (MUET), Jamshoro.

4. Prof. Dr. Muhammad Iqbal Bhatti — Member
Principal,
Ziauddin College of Bio-Medical Engineering,
F-103, Block B, North Nazimabad,
Karachi.

5. Prof. Dr. Ali Raza Jafri — Member
Act. Chairman,
Biomedical Engineering Department
NED University of Engineering and Technology
Karachi.

6. Dr. Ahsan Ahmad Ursani — Member
Chairman,
Department of Bio-Medical Engineering,
Mehran University of Engineering & Technology (MUET),
Jamshoro.

7. Dr. Asif Mahmood Mughal — Member
General Manager,
PMO (Electronics Dte),
NESCOM, P.O. Box 91, Opposite EME College, Rawalpindi.

8. Prof. Dr. M. Rafi Shaikh — Member
Bio-Medical Engineering
Faculty of Engineering Science & Technology,
Hamdard University, Karachi.

9. Dr. Bushra Noman Saeed — Member
Associate Professor,
Department of Biosciences/Stem Cells,
Shaheed Zulfikar Ali Bhutto Institute of Science and Technology (SZABIST),

90 Clifton, Karachi.

10. Engr. Abdul Aziz Sangi — Member
Bio-Medical Engineering
Faculty of Engineering Science & Technology,
Hamdard University, Karachi.

11. Engr Nadeem Saleem — Member
Bio-Medical Engineering
Faculty of Engineering Science & Technology,
Hamdard University, Karachi.

12. Engr. Muhammad Ali Bohyo — Member
Director, Institute of Biomedical,
Liaquat University of Medical & Health
Sciences, Jamshoro.

13. Engr. Syed Fahad Akbar Ali — Member
Assistant Professor
Bio-Medical Engineering Department
Sir Syed University of Engineering &
Technology, Karachi.

14. Engr. Inam Ul Ahad — Member
Assistant Professor,
Bio-Medical Engineering Department
Sir Syed University of Engineering &
Technology, Karachi.

The proceedings started with the recitation of Verses from the Holy Quran.

Mr. Muhammad Javed Khan, Adviser (Academics), HEC Islamabad welcomed the participants and briefed about the obligations of the Higher Education Commission for review, revision and development of curricula. He informed that Government is striving hard to enhance the quality of education in Public/Private sector Universities/Institutions by developing curriculum and making it more compatible with international standards, job oriented and in line with the needs of the society.

Dr. Muhammad Tahir Shah, (Deputy Director (Curriculum), HEC informed the members of the committee that the objective of the meeting is to finalize the draft curriculum in Bio-Medical Engineering prepared by this committee in the light of comments received from local and expatriate Pakistani experts.

Prof. Dr. M. A Haleem, Sir Syed University of Engineering & Technology Karachi acted as the Convener and Prof. Dr. Mirza Muhammad Javed as Secretary of the NCRC.

The convener of the meeting briefed the participants about the importance of Bio-Medical Engineering Degree programme that the modern hospital is now the center of a technologically sophisticated healthcare system; and this requires technologically articulate staff. Bio-Medical Engineering is the application of techniques drawn from engineering (electric, electronics, computer, chemical & mechanical) to the analysis and solution of problems in biology and medicine.

Bio-Medical Engineering focuses on health issues, aging populations around the world, growing expectations of the delivery of better medical devices and equipment designed by Bio-Medical Engineers. Employment of Bio-Medical Engineers is expected to grow fast than all occupations globally. This growing field needs immediate attention of government of Pakistan.

In practice, it involves everything from equipment for diagnosis and patient monitoring through implants such as pacemakers, artificial joints and limbs to the computer simulation of biological functions. All these modern aids to healthcare have to be conceived, designed, tested, manufactured, installed, operated, maintained and improved.

After three days of detailed deliberations, the National Curriculum Revision Committee developed/finalized curriculum in Bio-Medical Engineering at BE/BS and scheme of studies for ME/MS level.

The forum also made the following changes to the scope of undergraduate Engineering Domain Courses.

- Dr. Nasir Mehmood, Registrar PEC emphasized that the recommendations of PEC workshop on curriculum development and associated requirements held on 5-6 January, 2009, should be incorporated in its letter and spirit.
- The minimum duration of the BE/BS Programme in Bio-Medical Engineering will be four years.
- It was agreed that foundations courses of Mathematics and Biology (6, 5+1) for Pre-Engineering and Pre-Medical intakes, respectively, will NOT be counted towards minimum degree requirements.
- There will be four Mathematics courses to bring BME programme at par with other Engineering Programs.
- Minimum of 4 Years for BE/BS Bio-Medical Engineering programme.
- Professor Dr. M. A. Haleem, Dr. Nasir Mehmood and Professor Dr. Bhawani Shankar Chaudhry along with the other committee members revised and reviewed the scheme of studies developed by the NCRC and fused the foundation courses within the first semester. However, every institution has the freedom to offer the foundation semester separately.
- The new scheme will be applicable from batches of 2013 onwards.
- A suggested list of ME/MS core and elective courses is given while every University will have freedom to follow its own tracks. However,

every ME/MS program must follow the HEC regulations regarding admission and qualification.

Rationale:

The modern hospital is now the centre of a technologically sophisticated healthcare system and it requires highly-skilled professionals. Bio-Medical Engineering blends traditional engineering techniques with biological sciences and medicine to improve the quality of human health and life. Bio-Medical Engineer plays an indispensable role as a health care professional, working with the group that includes Physicians, Nurses, Therapists and Technicians.
Bio-Medical engineering concentrates on understanding complex living systems via experimental and analytical techniques and on the development of devices, methods and algorithms that advance medical and biological knowledge while improving the effectiveness and delivery of clinical medicine. Bio-Medical engineers may work in hospitals, universities, industry and laboratories. They enjoy a range of possible duties, including the design and development of artificial organs, modeling of physical processes, development of blood sensors and other physiologic sensors, design of therapeutic strategies and devices for injury recovery, diagnostics, physiological monitoring, development and refinement of imaging techniques and equipment, development of advanced detection systems, testing of product performance, and optimal lab design.

Bio-Medical Engineers specialize in a variety of functional areas, including bioinstrumentation, biomechanics, biomaterials, clinical engineering, computational biology, medical imaging, rehabilitation engineering, systems physiology and tissue engineering.

Therefore, unlike traditional engineering disciplines it is a multidisciplinary field and no single curriculum can encompass all its aspects. It depends on the available human resources, infrastructure and the auxiliary facilities. This curriculum provides the baseline framework for undergraduate and graduate biomedical curriculum and every university can choose their own track depending on their resources and needs.

As a Graduate in Bio-Medical Engineering, you will find an increasing range of job opportunities in the hospital service. You will also be able to secure a progressive career in a variety of sectors:

- Bio-Medical Engineer in all big Hospitals
- Medical support manufacture
- Medical systems development
- Research within academia/hospitals/product suppliers
- Government health service
- Clinical engineering
- Rehabilitation engineering
- Non-medical industrial specialists in device design & manufacture

- Development of new diagnostic instrumentation
- Analysis of medical device hazards & safety
- Design of telemetry systems for patient monitoring
- Healthcare Information System

ELIGIBILITY CRITERIA:

For undergraduate level

HSSC Pre-Medical and Pre-Engineering or equivalent.

For post graduate level

BS/BE Bio-Medical Engineering or other disciplines of engineering and MBBS subject to qualifying deficient courses.

FRAMEWORK/TEMPLATE FOR BE/BS IN BIOMEDICAL ENGINEERING

Duration:	4 years
Number of semesters:	8
Number of weeks per semester:	16-18 (16 for teaching and 2 for examinations)
Total number of credit hours:	**137**
Number of credit hours per semester:	15-19
Engineering Courses (Minimum):	70%
Non-Engineering Courses (Maximum):	30%

Non-Engineering Domain									
Knowledge Area	Subject Area	Name of Course	Lec CH	Lab CH	CR	Total Cour-ses	Total Cre-dits	% Area	% overall
Humanities	English	English I (Functional English)	2	0	2	3	7	20	5.11
		English II (Communication Skills)	2	0	2				
		English-III (Technical Report Writing and Presentation Skills)	3	0	3				
	Culture	Islamic Studies/Ethics	2	0	2	2	4	13.33	2.92
		Pakistan Studies	2	0	2				
	Social Sciences	Social Sciences	3	0	3	1	3	6.67	2.19
Management Sciences		Professional Practice & Ethics	3	0	3	2	6	13.33	4.38
		Economics & Healthcare Management	3	0	3				
Natural Sciences	Physics	Applied Physics	2	1	3	1	3	6.67	2.19
	Mathematics	Calculus and Analytical Geometry	3	0	3	3	9	20	6.57
		Linear Algebra & Differential Equations	3	0	3				
		Numerical Analysis	3	0	3				
	Core	Complex Variables & Transforms	3	0	3	3	9	20	6.57
		Biochemistry	2	1	3				
		Applied Chemistry	2	1	3				
TOTAL						**15**	**41**	**100**	**29.93**

Engineering Domain									
Knowledge Area	Subject Area	Name of Course	Lec CH	Lab CH	CR	Total Courses	Total Credits	% Area	% Overall
Computing	Fundamentals	Introduction to Computing	2	1	3	2	6	6.67	4.38
	Design	Modeling & Simulation	2	1	3				
Engineering (Biomedical) Foundation (Core)		Basic Electrical Engineering	2	1	3	9	25	30	18.25
		Physiology-I	2	1	3				
		Biophysics	2	1	3				
		Human Anatomy	2	1	3				
		Physiology-II	2	1	3				
		Digital Logic Design	2	1	3				
		Circuit Analysis	3	1	4				
		Probability & Statistics	2	0	2				
		Computer Aided Engineering Drawing	0	1	1				
Major Based Core (Breadth)		Basic Electronics	3	1	4	7	24	20.33	17.52
		Biomedical Electronics	3	1	4				
		Biomedical Instrumentation -I	3	1	4				
		Signals & Systems	3	1	4				
		Electromagnetism	2	0	2				
		Microprocessor & Interfacing	2	1	3				
		Bio-Signal Processing	2	1	3				
Major Based Core (Depth)		Elective-I	2	1	3	3	8	10	5.84
		Elective -II	2	0	2				
		Elective-III	3	0	3				
Inter-disciplinary Engineering Breadth (Electives)		Biomechanics	2	1	3	8	27	26.67	19.71
		Biomedical Control Systems	2	1	3				
		Biomaterials & Design	3	1	4				
		Bio Fluid Mechanics	2	1	3				
		Biomedical Instrumentation – II	3	1	4				
		Rehabilitation Engineering	2	1	3				
		Neurosciences & Neural Networks	3	1	4				
		Medical Imaging	2	1	3				

Senior Design Project		Biomedical Engineering Project	0	6	6	1	6	3.33	4.38
Industrial Training			0	0	0				
TOTAL						30	96		70.07
Grand Total							137		100%

Summary				
Domain	**Knowledge Area**	**Total Courses**	**Total Credits**	**% Overall**
Non-Engineering	Humanities	6	14	29.93%
	Management Sciences	2	6	
	Natural Sciences	7	21	
	Sub Total	**15**	**41**	
Engineering	Computing	2	6	70.07%
	Engineering (Biomedical) Foundation (Core)	9	25	
	Major Based Core (Breadth)	7	24	
	Major Based Core (Depth)	3	8	
	Inter-Disciplinary Engineering Breadth (Electives)	8	27	
	Senior Design Project	1	6	
	Industrial Training	0	0	
	Sub Total	**30**	**96**	
Grand Total			**137**	**100**

Scheme of Studies for BE/BS (4 Years) in Biomedical Engineering

Biomedical Engineering Curricula Under Uniform Framework

Course Title	Lec	Lab	CR	Course Title	Lec	Lab	CR
First Year							
English I (Functional English)	2	0	2	English II (Communication Skills)	2	0	2
Applied Physics	2	1	3	Calculus and Analytical Geometry	3	0	3
Introduction to Computing	2	1	3	Physiology-I (F-1)	2	1	3
Basic Electrical Engineering	2	1	3	Complex Variables & Transforms	3	0	3
Applied Chemistry	2	1	3	Biochemistry (NS-2)	2	1	3
Computer Aided Engineering Drawing	0	1	1	Human Anatomy (F-3)	2	1	3
Basic Mathematics/Basic Biology (Foundation) *	*6/5**	*0/1**	*0**				
Total	**16/15**	**5/6**	**15**	**Total**	**14**	**3**	**17**
First year Credit Hours	**32**						
** Basic Mathematics / Basic Biology are mandatory foundation courses to be treated as non-credit hours (CH)*							
Course Title	**Lec**	**Lab**	**CR**	**Course Title**	**Lec**	**Lab**	**CR**
Second Year							
Linear Algebra & Differential Equations	3	0	3	Biomedical Electronics (B-2)	3	1	4
Biophysics (F-2)	2	1	3	Numerical Analysis	3	0	3
Physiology-II (F-4)	2	1	3	Pakistan Studies	2	0	2
Basic Electronics (B-1)	3	1	4	Biomechanics (IDEE-1)	2	1	3
Circuit Analysis (F-7)	3	1	4	Digital Logic Design (B-3)	2	1	3
				Bio Fluid Mechanics	2	1	3
Total	**13**	**4**	**17**	**Total**	**14**	**4**	**18**
Second year Credit Hours	**35**						

Course Title	Lec	Lab	CR	Course Title	Lec	Lab	CR
Third Year							
Signals & Systems (B-4)	3	1	4	Bio-signal Processing (B-7)	2	1	3
Electromagnetism (B-5)	2	0	2				
Probability & Statistics	2	0	2	English-III (Technical Report Writing and Presentation Skills)	3	0	3
Microprocessor & Interfacing (B-6)	2	1	3	Biomedical Instrumentation-II (D-1)	3	1	4
Biomedical Instrumentation-I (B-6)	3	1	4	Biomedical Control Systems (IDEE-2)	2	1	3
Islamic Studies/Ethics	2	0	2	Modeling & Simulation (COMP-3)	2	1	3
				Rehabilitation Engineering	2	1	3
Total	**14**	**3**	**17**	**Total**	**14**	**5**	**19**
Third year Credit Hours	**36**						

Course Title	Lec	Lab	CR	Course Title	Lec	Lab	CR
Final Year							
Economics & Healthcare Management (MS-1)	3	0	3	Neuroscience & Neural Networks (D-5)	3	1	4
Social Sciences	3	0	3	Medical Imaging (D-4)	2	1	3
Biomaterials & Design (IDEE-3)	3	1	4	Professional Practices & Ethics (MS-2)	3	0	3
Elective-I (D-2)	2	1	3	Elective-III (D-6)	3	0	3
Biomedical Engineering Project – I	0	3	3	Biomedical Engineering Project - II	0	3	3
Elective-II (D-3)	2	0	2				
Total	**13**	**5**	**18**	**Total**	**11**	**5**	**16**
Final year Credit Hours	**34**						

Total Credit Hours	**137**

Internship: A Hospital/Industry Internship after the completion of 6th Semester should be made mandatory during summer as part of the degree requirements.

List of Elective Courses

The following may be offered as elective specialization courses according to the availability of resources in the respective educational institution.

Course Title	Pre-requisite
BM 374 Biophotonics	Biophysics
BM 375 Cell & Molecular Biology	Human Anatomy
BM 376 Fluid Mechanics & Heat Transfer	Applied Physics, Linear Algebra & Differential Equations
BM 377 Telemedicine	Introduction to Computing
BM 378 Medical Informatics	Programming Languages
BM 379 Circulatory Control in Biomedical Engineering	Physiology-I &II
BM 380 Medical Data System	Introduction to Computers
BM 476 Biomedical Engineering Systems	Biomedical Instrumentation-I
BM 477 Advanced Biomedical Instrumentation	Biomedical Instrumentation-II
BM 478 Computational Fluid Dynamics	Fluid Mechanics
BM 479 Adv. Biomedical Signals & Systems	Biosignal Processing
BM 480 Tissue Engineering	Biomaterials & Design
BM 482 Digital Image Processing	Biosignal Processing
BM 483 Artificial Intelligence & Expert Systems	Neurosciences & Networks
BM 484 Prosthetics & Artificial Organs	Biomaterials & Design
BM 485 Medical Image Analysis	Medical Imaging
BM 486 Power Electronics	Biomedical Electronics
BM 487 Rehabilitation Engineering	Biomechanics
BM 488 Medical Robotics	Mechanics
BM 489 Neuroimaging	Electromagnetism
BM 490 Genetic Engineering	Biochemistry
BM 491 Nano Biotechnology	Biotechnology
BM 492 Pharmaceutical Engg	Pharmacology
BM 493 Biomolecular Engg	Biophysics
BM 494 DNA Computing	Bioinformatics

DETAILS OF COURSES
FOR BE/BS IN BIOMEDICAL ENGINEERING

Title of the Course: **HS-111 English I (Functional English)**

Annexure-"A"

Title of the Course: BS-121 Applied Physics
Credit Hours: 2+1
Pre-requisites: None

Specific Objectives of Course:

The course is intended to provide knowledge about:

i) Properties of Matter and fluids
ii) Heat & Thermodynamics with introduction to heat transfer machine.
iii) Concepts of optics covering theory of light.
iv) Introduction to electricity and magnetism and its application in electrical and electronic field.

Course Outline:

Properties of Matter: Elasticity; modulus of Elasticity, Experimental determination of young's modulus, Bending of beams, Cantilever.
Fluids: Steady and turbulent flow, Bernoulli's theorem, Viscosity, determination of Coefficient of viscosity by Poiseuillie's method. Surface tension, Surface energy, Angle of contact, determination surface tension by rise in a capillary tube.
Heat & Thermodynamics: Heat, Temperature, Theories of heat, Adiabatic and isothermal processes, the four laws of thermodynamics, Thermodynamic functions, Efficiency of Heat Engines, Carnot's Cycle, , Entropy, Reversible Process and cycles, Thermodynamic equilibrium, Introduction to Heat transfer Mechanisms.
Optics: Waves and Oscillations, Simple Harmonic Motion, types of wave motion, theories of light, Interference, Diffraction, Polarization, Double refraction, Dispersion, Types and uses of Deviation Lasers.
Electricity and Magnetism: Electric charges, Electric field, Electric potential, Coulomb's law, Gauss's law, Capacitors and dielectrics, Electric current, Ohm's Law, Magnetic properties of matter, Magnetic field, Magnetic force on current, Ampere's law, Faraday's law, and Lenz's law.

Lab Outline:

Coulomb's Law, Gauss's law, Faraday's laws, Electricity & Magnetism, Laws of Optics, Lenz's law, Thermodynamics principles, Heat Transfer.

Recommended Books:

- David Halliday, Robert Resnick and Jearl Walker, WIE Fundamentals of Physics, 7th ed. 2005, John Wiley & Sons, ISBN:0471465097
- Arthur Beiser, " Schaum's Outline of Applied Physics, 4th ed. 2004, McGraw Hill, ISBN:0071426116
- Hobbie, Russell, Intermediate physics for medicine and biology-4th edition, 2007

- Cutnell & Johnson, Physics, John Wiley & Sons, 2008

Journals/Periodicals
World Wide Web: www.physicsdaily.com

Title of the Course: CS-111 **Introduction to Computing**
Credit Hours: 2+1
Pre-requisites: None

Specific Objectives of the Course:

An overview of Computer Science and information technology with applications. Number systems and Boolean algebra. Programming forms the core of Computer Science. Other aspects of the subject are either side-issues, or specializations from the basic programming core. Therefore Computer Programing is the core first-year course in all Electronics, Telecommunication, Biomedical & Computer Science degrees, and is an essential prerequisite to almost all that follows in the second and third year.

After the completion of the course, the students should be able to:

i) To write real working programms, albeit ones on a much smaller scale than those used in industry or sold as commercial software applications.
ii) Being able to think logically so one can predict in advance the behaviour of a system working to fixed set of rules.
iii) Computing and execution of C Program.

Course Outline:

Review: Basic programming concepts. arrays and strings.

Advanced Programming Concepts: data types, pointers and references, parameters passing, functions, classes, objects, headers and file linkages.

Filing & Interfacing: File handling, input output interfacing.

Graphics: Drawing functions, graphic modes.

Applications: Development of software for solving biomedical problems

Lab Outline:

Compilation, debugging, data types, pointers, functions, classes, headers, file linkages, Input/ output, file handling.

Recommended Books:

- Tanenbaum, Langsam and Augenstein, Data Structures Using C, Prentice-Hall.
- Mark A. Weiss, Data Structures and Algorithm Analysis in C++,
- Sahni, Fundamentals of Data Structures in C, Computer Science Press.

World Wide Web: www.microsoft.com, www.ocw.mit.edu.

Title of the Course: BS-131 Applied Chemistry
Credit Hours: 2+1
Pre-requisites: None

Specific Objectives of Course:
To review those aspects needed to learn concepts of biochemistry biophysics, bio-sensors and imaging.

Course Outline:

Introduction: Wave properties of electrons and matter Quantum theory of matter at atomic level, atomic structure. Energy levels, orbital, hydrogen spectrum, bond energy, molecular structure and its rotational and vibration energy
Chemical Bonding: Types of Bonds, Hybridization and Theories of Bonding. Valence Shell Electron Pair Repulsion Theory and Molecular Orbital Theory.
Physical state of matter. Gas laws, properties of liquid, surface tension, viscosity, optical activity, dielectric constant, polarization, dipole moment. Crystal structure
Chemical Kinetics: Rate of reaction, order of reaction, First, Second and third order reaction, factors affecting rate of reaction like Pressure, Temperature, concentration, catalyst, surface area and volume.
Electrochemistry: oxidation and reduction reactions, Balancing of redox reaction in acidic and basic medium. Construction of galvanic cell.
Organic chemistry: Introduction and classification of organic compounds. Saturated and unsaturated hydrocarbons. Chemistry of Alkanes, Alkynes, Alkenes and Aromatics. Nucleophilic and Electrophonic substitution Reactions.

Lab Outline:
Order of reaction, factors affecting rate of reaction, acid-base titrations, Redox's titrations, preparation of Acidic and Basic buffer solutions and mixture analysis.

Recommended Books:
- Silberberg Chemistry: The Molecular Nature of Matter and Change. McGraw Hill.
- John, R. Holum: Elements of General, Organic and Biological Chemistry. John Wiley & Sons

Title of the Course: EE-111 Basic Electrical Engineering
Credit Hours: 2+1
Pre-requisites: None

Specific Objectives of Course:
To give adequate knowledge and clear understanding about the concept of Basic electrical engineering.

Course Outline:

Review: Structure of Matter, Conductors, Insulators and Semiconductors, Electric Current, Electromotive Force (Voltage), Resistance, Conventional Current, DC and AC, Ohm's Law, Work, Energy, and Power, Conductance, Efficiency, Real and ideal Sources. Resistive Network: Kirchoff's voltage and current Laws, The Voltage-Divider Rule, the Current-Divider Rule, Series and Parallel Connected Sources, Y-Delta Transformations, Balanced Bridges, voltage and Current Source Conversion,

Network Theorems: The Superposition Theorem, Maximum Power Transfer Theorem.

Capacitance and Capacitors: The Nature of Capacitance, Capacitor Dimensions and Dielectrics, Capacitor Types and Ration, Transients in RC Networks, Energy Stored in a Capacitor.

Inductance and Inductors: Electromagnetic Induction, Lenz's Law, Faraday's Transformer Action, Self Inductance, Inductor, Transients in RL Circuits, Energy Stored in Inductors.

Poly Phase Systems: Three phase circuits and balanced loads.

Transformers and AC Machines: General principle, working, fundamental equations, types, efficiency and losses.

Motor Controllers and Drives: DC & AC Drives, Speed control of motors, Stepper motor Drive.

Lab Outline:

Measuring instruments like multimeter, oscilloscope, etc. Ohm's Law, Krichhoff's Current, Voltage Law, Current Divider Theorem, Voltage Divider Theorem, Study of Superposition Theorem, Maximum Power Theorem, Thevenon's Theorem. Study of RLC Series Circuits, RLC Parallel Circuits, Simulation of Basic Electrical Circuits Using PSpice, Orcad or Electronic Workbench.

Recommended Books:

- David Irwin, Engineering Circuit Analysis, Wiley.
- Electrical Circuit Analysis by William H. Hayat, Mac-Hill.

Computer Aided Engineering Graphics

Credit Hours 0+1

Course Outline:

Introduction to Computer Aided Drafting:

Introduction to orthographic projection and isometric drawings and basic concepts of conventional engineering drawings. Opening a new drawing, paper setting, coordinate systems: User's coordinate system (UCS), Cartesian coordinates and Polar coordinates; saving a drawing. **Creating Elementary Objects:**

Apply the commands: Grid, ortho, escape, erase, trim, undo. Draw: lines, circles, ellipse, rectangle and arcs. **Basic Object Editing:**

Apply the following commands: Move, offset, rotate, fillet, chamfer, array and mirror. **Dimensioning:**

Show the following dimensioning: Linear, aligned, radial and changing dimensional setting. **Solid Modeling:**
Apply the following commands to create 3-D models: Region, extrude, revolve, slice and show plan; elevation and end view of a 3-D model.
Controlling Drawings:
Apply the following commands for a given drawing: Hatching, coloring and rendering.

Text:

Apply the following commands on the given drawing: Creating text, style of text and changing text properties. **Plotting Drawings:**
Apply the following commands: Plotting, print preview and printing.

Recommended Books:

- *Engineering Design Graphics with AutoCAD; James H. Earle.*
- *Department of Bio-Medical Engineering 2007, Addison Wesley.*
- *Technical Graphics Communication; Gary Robert Bertoline, Eric N Wiebe, Nathan W. Hartman, William A. Ross, 4th Ed. 2008, McGraw-Hill.*
- *AutoCAD 2008: A Problem Solving Approach; Sham Tickoo, 1st Ed. 2007, Autodesk*

Title of Subject: Complex Variables & Transforms
Credit Hours 3+0

Objectives:

After completing this course, the student should be familiar with:

Course Outline

The complex number and complex variables. Complex differentiation and contents: integration. Laplace Transformation and its applications. Series solution of the DEs. Complex number systems and Complex Variable theory: Introduction to complex number systems. Argands diagram, modulus and argument of a complex number, polar form of a complex number, De Moivres theorem and its applications. Complex functions, analytical function, harmonic and conjugate harmonic functions, Cauchy-Remann equations (in Cartesian and polar coordinates). Line integral, Greens theorem, Cauchys theorem, Cauchys integral formula, singularities, poles, residue and contour integration and application.

Laplace Transforms: Definition, Laplace transforms of elementary functions. Properties of Laplace transform, Laplace transform of derivatives, integrals. Multiplication by t and division by t properties. Periodic functions and their Laplace transforms. Inverse Laplace transforms and their properties. Convolution theorem. Inverse Laplace transforms by integral and partial fraction methods. Heavisides expansion formula. Solution of ordinary differential equations by Laplace transform. Applications of Laplace transformation on various fields of engineering. Series Solution of Differential Equations: Introduction.

Validity of series solution. Ordinary point, singular point. Forbenius method, indicial equation. Bessels differential equation, its solution of first kind and its recurrence formulae. Logendre differential equation and its solution. Rodriguez formula. Fourier Transform: Definition, Fourier transform of simple functions, magnitude and phase spectra, Fourier transform theorems, Inverse Fourier transform, Solution of differential equation using Fourier transform.

Recommended Books:

- H. K. Dass, Advanced Engineering Mathematics.
- Dr. B. S Grawall, Advanced Engineering Mathematics.
- Erwin Crayzig, Advanced Engineering Mathematics.
- Laplace Transform, Schaum Series

Title of the Course: HS-112 English-II (Communication Skills)
Credit Hours 2+0

Annexure "A"

Title of the Course: BS-142 Calculus and Analytical Geometry
Credit Hours: 3+0
Pre-requisites: None

Specific Objectives of the Course:
To give the idea of calculus and its applications in the engineering field.
After completion of this course the student should be able to:

i) Know the derivative as a rate measurer, slope of a straight line etc and integration as the area under curve.
ii) Solve the application problems related to their field
iii) Know the vector algebra and vector calculus.

Course Outline:
Introduction to Functions: Mathematical and physical meaning of functions, graphs of various functions. Hyperbolic functions.

Introduction to Limits: Theorems of limits and their applications to functions. Some useful limits, right hand and left hand limits. Continuous functions and their applications.

Derivatives: Introduction to derivatives. Geometrical and physical meaning of derivatives. Partial derivatives and their geometrical significance. Application problems. (Rate of change, marginal analysis).

Higher Derivatives: Leibnitz theorem, Rolles theorem, Mean value theorem. Taylors and Maclaurins series.

Evaluation of Limits Using L' Hopital's Rule: Indeterminate forms.

Applications of Derivatives: Asymptotes, tangents and normals, curvature and radius of curvature, maxima and minima of a function of single variable (Applied problems), differentials with application. Euler's theorem, total differentials, maxima and minima of two variables.

Integral Calculus: Methods of Integration by substitutions and by parts. Integration of rational and irrational algebraic functions. Definite integrals, improper integrals, Gamma and Beta functions, reduction formulae. Cost function from marginal cost, rocket flights, area under curve, etc.

Vector Algebra: Introduction to vectors. Scalar and vector product of three and four vectors. Volume of parallelopiped and tetrahedron.

Recommended Books:

- Doniel D. Bebice "Brief Calculus and its applications"
- Raymond A. Barnett "Applied Calculus"
- Gerald L. Bradley "Calculus"
- Dr. S.M. Yusuf "Calculus and analytical geometry"

Title of the Course: Bio Fluid Mechanics

Credit Hours: 2+1
Pre-requisites: Biophysics

Course Outline

Basic concepts in fluid mechanics: Viscosity, surface tension, compressibility; hydrostatics, pressure on plate; kinetics & kinematics of fluid flow; continuity equation; conservation of momentum; Bernoulli's equation; Poiseuille equation; viscous, unsteady flows; dimensional analysis. Physiological Fluid Mechanics:
Introduction to blood flow in the circulatory system, respiration, peristaltic motion, ciliary and flagellar transport, Rheology of blood and blood vessels, static and steady flow model, native heart valve, Fluid dynamics measurement techniques

Recommended Books:

- Introduction to Bioengineering; Berger S. A., Goldsmith, W. and Lewis E. R., 1996
- Fundamentals of Fluid Mechanics; Munsen B. R., Young D. F. and Okiishi T. H., ed. 2006, John Wiley & Sons, Inc.
- Fundamentals of Heat and Mass Transfer; Incropera, F. P. and De Witt, D. P., 5th ed. 2002, John Wiley & Sons, Inc. Transport Phenomena.
- K. B Chandran, A. P. Yuganathan, Stanley E Rittgers, Biofluid mechanics Human circulation, CRC Taylor and Francis, 2007.

Title of the Course: BM-113 Physiology-I

Credit Hours: 2+1
Pre-requisites: None

Specific Objectives of the Course:

The use of physiology in bio-medical engineering is to help improve medical diagnosis and treatment and to improve the quality of life for people who are incapacitated injured.
The course is intended to provide the knowledge about:
i) To set trends for finding physiological parameters with accuracy &

precision with subject human body.

ii) Advance development for techniques of interfacing electro-medical equipment

iii) To study on physiological processes in helping physician & constant for offering best medical facilities with respect to biomedical devices.

Course Outline:

Introduction to Physiology: The Cell and General Physiology. Functional organization of human body and control of the internal environment. Cell and its function, protein synthesis and cell reproduction. Metabolism of carbohydrates and formation of ATP. Lipid and Protein Metabolism, transport through Cell membrane.

Human physiology from a system's view point: Quantitative issues at the organ and whole body levels of:

a) Cardiovascular
b) Respiratory
c) Renal and
d) Digestive systems.

Nerve and Muscle: Membrane potential, Action potential, Excitation and Rhythmicity. Contraction of Skeletal and cardiac muscles, sliding filament Mechanism, Heart as a pump.

Sensory Systems: Sensory Receptors: Classification and basic mechanism of action.

Somatic Sensations: Mechanoreceptive sensations, pain, thermal and visceral pain, headache.

Special Senses: Eye, receptor function of the retina, Neurophysiology of Vision, the Chemical Sense-taste and smell.

LAB OUTLINE:

S. No	**TITLE OF PRACTICALS**
1	Use of stethoscope & measurement of human arterial blood pressure & pulse
2	Determination of Red Blood Cells per cumm of human Blood
3	Determination of White Cells per cumm of human blood
4	Determination of haemoglobin percentage in human blood
5	Physiochemical & microscope analysis of human urine sample (Renal System)
6	a) Demonstration of the use of ECG b) Test of hearing
7	Determination of visual acuity of a human subject by using snellen’s eye chart
8	Determination of bleeding time in human body

9 Determination of the coagulation time in human body

10 a) To record normal respiration & effect of exercise on it using spirometer.
b) To record normal respiration & effect of exercise on it using power lab.
c) Introduction the organization & classification of neurons using neurolab

11 a) To record normal respiration & effect of exercise on it using spirometer
b) To record normal respiration & effect of exercise on it using power lab
c) Introduction the organization & classification of neurons using neurolab

12 To demonstrate the differential count of leukocytes in human blood Sample

13 To observe the shape of RBC in normal saline

14 To identify various parts of digestive tract & to observe cut mobility in exposed abdomen of dissected rabbit

15 To determine the group of blood sample

Recommended Books:

- A. C. Guyton, A Text-Book of Medical Physiology, 12th Ed, 2010.
- William F., Review of Medical Physiology 22nd Ed, 2005.
- Arthur C. Guyton, John E. Hall, Textbook of Medical Physiology: with STUDENT CONSULT Access (Textbook of Medical Physiology)
- Robert M. Berne (Editor), Physiology.
- Linda S. Costanzo, Physiology (Board Review Series) (3rd Edition)
- Elaine N. Marieb, Essentials of Human Anatomy & Physiology with Essentials of InterActive Physiology CD-ROM (8th Edition)

Title of the Course: BM-121 **Biophysics**

Credit Hours: 2+1

Pre-requisites: Applied Physics

Specific Objectives of the Course:

The object of this course is that the student could appreciate the function of various bio-medical instruments built on the basics of bio-physical principles.

Course Outline:

Sound: Hearing and Echolocation, Ultrasound.

Optics of Vision: Quantum Nature of Vision.

Nervous system: Biophysics of Neural Spike. Information theory and Memory; Nervous system.

Structural Biophysics: Conformational analysis and forces that determine protein and nucleic acid structure. Molecular Modeling of protein, nucleic

acid structures.

Radiation and Radiobiology: Interaction of radiation with matter, Biological effects of radiation, radiobiological effects of radiation, medical imaging using radio-isotopes.

Biopotentials: Electrocardiograms and electric shocks, Fundamental laws for current in biological tissues, Biopotentials in hearts, electrocardiogram, Action potentials in nervous system.

Bioenergetics: Thermodynamic principles. First law (energy, enthalpy), Second law of Thermodynamics. Free energy, standard physical free energy and standard biological free energy, determination of the free energy from equilibrium constant and EMF measurements. Thermodynamics of phosphate compounds (phosphate transfer reactions) and role of ATP for biological energy transfer, thermodynamics of life.

Energy Pathways: Coupled Reactions, Group Transfer Potential, Role of Pyridine Nucleotides, Energy Conversion Pathways, Biological Membrane, Active Transport, Chemi-osmotic theory-passive transport.

LAB OUTLINE:

S. No	**TITLE OF PRACTICALS**
1	Molecular Graphics of Peptide Unit
2	Molecular Graphics of Proteins
3	To find out the ionization constant of given acid (Acetic Acid) by pH titration curve
4	To find out the maximum absorption of Riboflavin by Spectrophotomer and determination of molar extinction co-efficient
5	To calculate potential energy of biomolecules on the basic of non bonded interactions
6	Potential energy determination on the basis of electrostatics Forces
7	Determination of free energy for Redox reactions in biological System
8	Determination of Redoxpotential for Cytochrome Fe^{++}
9	Demonstration of Sound and hearing (organ and pathway) by models and Computers
10 .	Tests of hearing and tests of vision
11	Demonstration of the taste and smell by models and Computers
12	To determine the standard curve of Riboflavin by Spectrophotometer
13	To locate the blind spot of the object by using Neurolab or similar software
14 .	Determination of frequency, Intensity and airflow of speech phonics using phonatory function analyzer
15 .	Demonstration of Ultrasound
16	To observe and analysis of the different types of errors and disease of Eyes by using the Neurolab software or similar software.

Recommended Books:

- V. Pattabhi, N. Gautham, Biophysics
- Christaan Sybesma, Biophysics, Kluwer Academic Publications.
- Henrik Flyvbjerg (Editor), Physics of Bio-Molecules and Cells, et al

- Forces, Growth and Form in Soft Condensed Matter: At the Interface between A. T. Skjeltorp (Editor), A. V. Belushkin (Editor), Physics and Biology (NATO Science Series II: Mathematics, Physics and Chemistry)
- Becker , Oren M, Computational biochemistry and biophysics, 2001
- Paul, Davidovitis, Physics in Biology & Medicine, 3rd Ed, 2007.
- World Wide Web: www.physicsdaily.com

Title of the Course: **BM-112 Human Anatomy**
Credit Hours: 2+1
Pre-requisites: None

Specific Objectives of the Course:

The aim of this course is to give the students basic information on normal structure of human body.

i) At the end of the course, students are expected to be able to describe and compare the principle structures of major human organs and systems.
ii) Discuss the anatomical basis of the circulation and the peripheral nervous system.
iii) Discuss the anatomical basis for actions such as breathing and digestion.

Course Outline:

Introduction: Anatomy and its branches, Anatomical positions, planes, topography.
Cell Anatomy: Overview of Cellular Anatomy.
Extremities (Upper and Lower): Bones, muscles, ligaments, tendons, bursae, reticulae, capsules, arteries, veins, Lymphatic system.
Vertebral Anatomy: Vertebrae, Pelvic girdle, spinal cord, nervous system.
Thorax-Thoracic Viscera: Surface anatomy, bones surface musculature, lungs, heart.
Abdomen: Organs (location, structures, relations and function).
Head & Neck: Bones, muscles, cranial nerves (location, structures, relations and function).

LAB OUTLINE:

S. No.	TITLE OF THE PRACTICALS
1	Demonstration of Human Skeleton in general
2	Demonstration of basic structures in Human Anatomy (Skin, Muscles & Other Structures)
3	Demonstration of Anatomical planes & positions
4	Demonstration of Movements & Motinal Terms
5	Demonstration & Study of Scapula & Clavicle
6	Demonstration & Study of Humerus bone
7	Demonstration of Ulna and Radius
8	Demonstration of wrist & hand bones
9	Demonstration of Pelvic bone
10	Study and demonstration of Femur bone

11 Study and demonstration of Tibia & Fibula
12 Demonstration of Foot bones
13 Demonstration of skull
14 Demonstration & study of different parts of Vertebral column
15 Study and Demonstration of different Models
16 Audio & Visual Demonstration of Human Anatomy

Recommended Books:

- Snell, Clinical Anatomy for Medical Students 8th Ed.
- Gerard J. Tortora, Principles Of Human Anatomy Along With (A Photographic Atlas Of The Human Body)
- Ellis, Horlad, Clinical Anatomy. A Revision & Applied Anatomy For Clinical Students-Ed-10th.
- Chaurasia's B. D, Human anatomy regional & applied vol-1. 4th ed, 2007
- Frederic H. Martini Human Anatomy (4th Edition), et al
- Human Anatomy Plus Human Anatomy Place CD-ROM and Access to Human Elaine N. Marieb, Anatomy Place Website (4th Edition) et al
- Michael McKinley, Human Anatomy Valerie O'Loughlin

Title of the Course: BS 243 Linear Algebra & Differential Equations

Credit Hours: 3+0

Pre-requisites: Calculus & Analytical Geometry

Specific Objectives of Course:

i) To develop the knowledge of matrix Algebra, the system of linear equations.
ii) To give an idea about formation, solution and the physical application of ordinary differential equations.

Course Outline:

Linear Algebra: Methods for solution of algebraic linear equations.
Vectors: Scalar and vector quantities, Differentiation and integration of vector functions. Gradient, Divergence and Curl. Line integrals, Green's Theorem, Gauss, divergence theorem, Stokes' theorems
Ordinary Differential Equations: Formulations, Order, degree and linearity of differential equations. Complementary and particular solutions, initial and boundary value problems. Solution of Ordinary Linear Differential Equations of First Order: Methods of solutions, Bernoulli's differential equations.
Linear Second Order Differential Equations: Characteristic equation and different types of it. Methods of solving homogeneous linear differential equations with constant coefficients. Particular solution by variation of parameter's method and solution by indeterminate coefficient method.

Recommended Books:

- Erwin Kreyszig, Advanced Engg. Mathematics
- S. H. K. Dass, Advanced Engg. Mathematics

Title of the Course: **BM 232 Biochemistry**
Credit Hours: 2+1
Pre-requisites: Applied Chemistry

Specific Objectives of the Course:

i) To provide an introduction to the basic concepts of biochemistry.
ii) To learn about the structure, classification and functions of protein and enzymes.
iii) To learn about the lipids, vitamins & carbohydrates.

Course Outline:

Introduction to Biochemistry: Colloidal state, buffer, pH, significance of pH Henderson equation, surface tension, viscosity, osmosis, diffusion, concept of chromatographic techniques (TLC, paper chromatography, GLC column chromatography etc.) carbohydrates, amino acids, nucleic acids, proteins, vitamins, enzymes, hormones & signaling agents,.
Metabolism of Carbohydrates, Lipids and Proteins: carbohydrate derivatives, optical activity, polarimetry, glycogenesis, gluconeogenesis, glycolysis, tricarboxylic acid cycle, hexose monophosphate shunt. Effects of hormones on carbohydrate metabolism. Chemistry and Metabolism of Lipids, Proteins

LAB OUTLINE:

S. No	TITLE OF PRACTICALS
1.	(a). General test for carbohydrates
.	(b). General test for polysaccharides
2.	Determine the pH of different given samples
3.	To study the cell fragility
4.	Estimation of Blood glucose level
5.	To detect essential amino acids color reaction test.
6.	To determine the protein in the given solution
7.	Isolation of casein from milk.
8.	Isolation of glycogen from liver.
9.	To find out viscosity of the given solution
10.	To study colorimeter
11.	Estimation of plasma cholesterol level.
12.	Effect of temperature on enzyme activity.
13.	Separation of amino acids by chromatography
14.	Study of nucleic acid (Software)
15	Preparation of solutions (Buffers)

Recommended Books:

- Lippincott, Bio-Chemistry 5th Ed, 2010
- Donald Voet, Judith, G. Voel and Charlotte, W. Prats, Fundamentals of Biochemistry, 2006, John Wiley & Sons.
- Rodney Boyer, Modern Experimental Biochemistry, Pearsons Education, Delhi, India.
- Tsai.C.Stan, An Introduction To Computational Biochemistry
- Sawhney S.K., Introductory Practical Biochemistry
- David L. Nelson, Michael M. Cox, Lehninger Principles of Biochemistry,

5th ed. 2008
- Bundred, I, Biochemistry 2nd Ed, 2007
- Raju, SM , Illustrated medical Biochemistry, 2005
- Dutta, Rajiv, Fundamental of Biochemistry engg, 2007
- Jeremy M. Berg, & Lubert Stryer, Biochemistry, 6th Ed, 2006

Title of the Course: BM-214 Physiology-II

Credit hours 2+1
Pre-requisites: Physiology I

Specific Objectives of the Course:

The use of physiology in bio-medical engineering is to help improve medical diagnosis and treatment and to improve the quality of life for people who are incapacitated injured.
The course is intended to provide the knowledge about nervous system, motor functions and endocrinology.

Course Outline:

Nervous System: Organization of Nervous System, Basic functions of synapses ; Neuronal Mechanism and circuits for processing information.
Motor Functions: Spinal cord and the cord reflexes; the cerebral cortex and intellectual functions of the Brain. Motor function of the Brain stem. Vestibular control of postural reflexes, Cerebrum and basal ganglia. Reticular formation.
Behavioral functions of the Brain: Limbic System, role of the Hypothalamus, and control of the vegetative functions of the body; the Autonomic nervous system; the Adrenal Medulla. Electrical Activity from Brain.
Endocrinology and Reproduction: Introduction to Endocrinology and the pituitary Hormones; Hormonal functions in male and female.

LAB OUTLINE:

S. No	TITLE OF THE PRACTICALS

1. To observe the receptor adaptation associated with Paccinian Corpuscle and other receptors in a computer simulated program
2. Determination of visual field in human subject.
3. Observe the relationship between the sound waveform and its spectrum using the computer simulated program
4. Observe and study the spectrum and waveforms of different vowels sound and their relationship with the configuration of the vocal tract
5. Study the movement in basilar membrane during the passage of sound waves of different frequencies, on a simulated model
6. To illustrate the principle of phase locking in auditory fibers by using the compute simulated program
7. To study the principle of interaural delay for sound localization or locating the position of source of sound using the simulated program
8. Demonstration: Use of an oscilloscope for the recording of nerve action potential
9. (a) To calculate nerve conduction velocity from twitch records obtained by using a nerve-muscle preparation using Kymograph.

(b) To calculate nerve conduction velocity from twitch records obtained by using a nerve-muscle preparation using powerlab. To locate the gustoreceptors in the human

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    (b) To calculate nerve conduction velocity from twitch records obtained by using a nerve-muscle preparation using powerlab. To locate the gustoreceptors in the human
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    (b) To calculate nerve conduction velocity from twitch records obtained by using a nerve-muscle preparation using powerlab To locate the gustoreceptors in the human
12 To elicit various spinal reflexes in human being.
13. Demonstration of various common (daily use) examples for the understanding of spinal reflexes
14. Demonstration of the recording of an (extracellular) action potential from frog sciatic nerve (monophasic & biphasic) on oscillograph / oscilloscope
15. Study of reflex movements in spine of frog; Effect of acid treatment, Effects of electric shock & Effect of Strychnine
16. Study of superficial, pupillary, cutaneous and kinaesthetic reflexes in human

Recommended Books:

- A. C. Guyton, A Text Book of Medical Physiology, 12th Ed, 2010
- William F., Review of Medical Physiology 22nd Ed, 2005

Title of the Course: BM-221 Basic Electronics

Credit Hours: 3+1

Pre-requisites: Basic Electrical Engineering

To study the fundamentals of Solid-State Electronics, the construction and function of Electronic Devices, and their applications, to be familiar with power electronic devices such as Thyristor, SCR, DIAC, and TRIAC

Course Outline:

Semiconductors: Atomic structure of Elements, Energy level diagram for solids, Intrinsic and Extrinsic semiconductors, Electron hole pairs, Distribution of electrons, combination & Regeneration.

Diodes: P-N Junction, Ideal diode, Real diode, Large & Small signal operation, Application of Diodes in half wave rectification, full wave rectification, equivalent circuit, Zener & Special purpose diodes, voltage regulation.

Bi-Polar Junction Transistors: Operation of BJT, Static characteristic, Q-Point, Amplification, A.C. loading, D.C. circuit analysis, Cut-off point, Break Down voltage, Transistor as a switch, Transistor configurations and Biasing.

Field Effect Transistors: Operation of FET, Output characteristics, Transfer characteristics, N-channel and P-channel J-FET, Biasing circuit, Q-point. MOSFET, N-channel and P-channel MOSFET, Small signal Analysis, low frequency and High frequency small signal Model.

Introduction to Power Electronic Devices: Introduction to Thyristor, SCR, DIAC, TRIAC, Phase controlled rectifiers/ Inverter circuits, step down & step up choppers.

Applications: Power electronics in medical equipment.

Lab Outline:

Study of forward and reverse bias characteristic, Study Characteristics, Zener Diode, LED, Tunnel Diode, Laser Diode, Photo Diode, Reverse of Recovery Times of Diode, PNP & NPN Transistor Characteristics, Photo Transistor, JFET, MOSFET, Rectifiers (Half wave, Full Wave, Centre Tape and Bridge Rectifier.).

Recommended Books:

- Manera A. S. “Solid State Electronic Circuits”
- Crovic M. M. “Basic Electronic Devices, Circuits and Systems” Reston Publishing Co.
- Steward H. E. & Annyn “Engineering Electronics” Becon Inc.
- Robert B. Northrop, Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation (Biomedical Engineering)
- Howard M Yanof (Author), Textbook of Biomedical Electronics, [sic]

Title of the Course: EE-212 **Circuit Analysis**

Credit Hours: 3+1

Pre-requisites: Basic Electrical Engineering

Specific Objectives of Course:

On completion of this course the students will be able to:

i) Understand the concepts of Electrical Circuits of AC & DC.
ii) Discuss various concepts of Theorems. Draw the equivalent circuits.
iii) Apply and understand the Inductive, capacitate and resistive circuits in series and in parallel.
iv) Determine the steady state and transient circuits.
v) Explain the forced, natural and total responses.
vi) Explain the exponential, sinusoidal excitations and their responses.
vii) Describe the circuits in time and frequency domains

Course Outline:

The RLC Circuits: Source Free Series & Parallel RLC Circuits, over-damped, under-damped, critically damped RLC Circuits, complete response of RLC Circuits, Lossless LC Circuits.

The Sinosoidal Steady Response: Nodal, Mesh & loop analysis, AC source Transformation, Thevenin’s, Norton’s, Reciprocity & Compensation theorems.

Complex Frequency: Introduction to complex frequency damped sinosoidal forcing function, Laplace Transform, Z(s) & Y(s), frequency response as a function of s, Complex frequency plane, natural response & the S-Plane. Voltage ratio synthesizing, Scaling & Bode Diagrams.
General Two Port Networks: Introduction, admittance parameters, some equivalent networks, impedance parameters, hybrid parameters, transmission parameters.

Lab Outline:

Steady state response of RLC Circuits. Node, Mesh & Loop Analysis, Transient response of RLC circuits, damping and stability,

Recommended Books:

- William Hayt, Engineering Circuit Analysis 5th Ed
- David Irwin, Engineering Circuit Analysis, Wiley.
- J. S. Kang, PSPice Manual for Electric Circuits Fundamentals, Oxford Univ. Press.
- M. E, Valkenburg, Network Analysis, Prentice Hall, Inc.
  Joseph J. Carr, John M. Domach, Network Analysis with Application-4th Ed.
- S. Franco, Electric Circuits Fundamentals, Oxford University Press.
- Wilhelm C. Miller, Circuit Analysis: Theory & Practice, 3rd Ed.
- Robert L. Bolestad, Introductory Circuit Analysis (10th Edition)
- John O'Malley, Schaum's Outline of Basic Circuit Analysis
- Paul R. Gray, Analysis and Design of Analog Integrated Circuits (4th Edition)

Title of the Course: HS-231 Social Sciences:

Annexure-"B"

Title of the Course: **BM-222 Biomedical Electronics**
Credit Hours: 3+1
Pre-requisites: Basic Electronics and Circuit Analysis

Specific Objectives of Course:

To have basic concepts of amplifier, power amplifier, operational amplifier and instrumentation amplifier, to be able to use OP-AMP as pre-amplifier, power amplifier, oscillator, filter, to perform mathematical operations on signals using OP-AMP, and to design various timing circuits using OP-AMP

Course Outline:

Amplifier Characteristics: Input and output impedance, Real and Apparent gain, Amplifier loading, Impedance matching of amplifiers.

Power Supplies*:* Regulated and switched mode power supplies.

Power Amplifiers: Classes of Power amplifiers.

Oscillators: Hartley oscillators, Colpitt oscillators, RC phase shift oscillators, Wein-Bridge oscillators, Crystal oscillators based on BJT and FET.

Differential Amplifiers: Darlington transistor circuit, properties of differential amplifier stage, circuits of differential amplifiers using BJTs and FETs.

Operational Amplifiers: Analysis of OP-AMP action, OP-AMP specifications: interpreting OP-AMP data sheet, offset voltage and current, temperature rating, output swing, CMRR, slew rate,

Applications: Inverting amplifiers, non-inverting amplifiers, voltage follower, summing amplifiers, instrumentation amplifiers, integrator, differentiator, non linear amplifiers. Frequency response of OP-AMPs, A/D and D/A converters, power control using Op-Amp, Op-Amp based timing circuits.

Recommended Books:

- Cirovic, M. M., "Basic Electronic Devices, Circuits and Systems", Prectice-Hall.
- Hayt and Neudeck, "Electronic Circuit Analysis and Design", Houghton Mifflin Company, Boston.
- Robert F. Coughlin, "Operational Amplifiers & Linear Integrated Circuits, 4th Ed.
- Howard M. Berlin, Fundamental of Operational Amplifiers & Linear Integrated Circuits
- Reinaldo Perez, Design Of Medical Electronic Devices
- Malvino, Principles of Electronic Devices.
- Thomas L. Floyd, Electronic Devices.

Title of the Course: **Numerical Analysis**

Credit Hours: 3+0

Pre-requisites: Linear Algebra & Differential Equations

Specific Objectives of Course:

After completing this course, the student should be familiar with:

i) Root of a non-linear equation f (x) = 0 and its computation.
ii) Iterative methods for the solution of simultaneous linear algebraic equations.
iii) Interpolation and extrapolation.
iv) Numerical differentiation and integration.
v) Numerical solution of ordinary and partial differential equation.

Course Outline:

Introduction, Error analysis: floating points, errors and types of errors. Solution of non-linear equation: Bisection, Regula-Falsi, Fixed-point iterative and Newton-Raphson's methods. Solution of linear algebraic

equations. Direct methods: Crout's and Cholescky methods; Iterative methods: Jaccobi's and Guass-Seidal methods. Eigen values and eigen vectors: Characteristics equation and, Power methods. Interpolations and extrapolations: Forward, backward, central difference operators and their relations. Newtons Forward, Backward and Divided Difference Interpolation Formulae. Lagrange's and Stirling's Interpolation Formulae. Numerical differentiation: Newton's-Forward and Backward differentiation Formulae. Numerical quadrature: Trapezoidal, Simpson's one-third, Simpson's three-eight and Weddle's rules and Gaussian quaderature. Solution of ODEqus: Taylor Series, Euler's and its modified, Runge-Kutta, Miline's, Adam-Moltan (Predictor-Corrector) methods. Solution of Higher Order Differential Equations: Runge-Kutta methods. Solution of Partial Differential Equations by Finite Differences Methods (Explicit, Implicit and Crank-Niclson techniques) and ADI Method.

Recommended Books:

- Dunn, Stanley M, Alkis Conastantinides, Numerical methods in biomedical engineering 2006
- Canal and Chapra "Numerical Methods for Engineers".
- Curits F. Gerald "Applied Numerical Analysis".
- Erwin Kreyszig "Advanced Engineering Mathematics".
- Chung Yau Lam "Applied Numerical Methods for the Solution of Partial Differential Equations"
- Dr Saeed Akhtar Bhatti "A First Course in Numerical Analysis".
- John L. Van Iwaarden "Ordinary Differential Equations with Numerical Techniques".

Title of the Course: HS-241 Pakistan Studies

Annexure "C"

Title of the Course: BM-231 Biomechanics

Credit Hours: 2+1

Pre-requisites: Biophysics, Physiology

Specific Objectives of Course:

The generate knowledge base in:

i) Mechanics of Rigid bodies.
ii) Bio-mechanical properties of human body.
iii) Bio-mechanics of upper limb.
iv) Bio-mechanics of lower limb.
v) Bio-mechanics and rehabilitation in the light of a real world example, such as wheel chair biomechanics etc.

Course Outline:

Statics: General principles of Statics, laws of triangle, Parallelogram and polygon forces, Equilibrium of rigid body, Free body Diagrams. Trusses, Methods of Joints and section for force analysis. Shear force and bending moments. Application of these forces with analysis in human body.

Dynamics: Rectilinear and curvilinear motion, Rotational mechanics,

Simple and multiple degrees of freedom, Application of these motions in human body and prosthetics.

Fluid Mechanics: Basic concepts of Fluid Mechanics, Hydrodynamic lubrication of natural and normal synovial joints.

Biomedical Applications: Mechanical properties of biological tissues and tissue mechanics, cardiac mechanics and modeling, muscle mechanics, gait kinetics, kinematics and analysis. Stress analysis and application to musculoskeletal system.

LAB OUTLINE:

S. No	TITLE OF PRACTICALS
1	Dynamometry of human foot by virtue of body weight
2	Measurement of angular orientations for limbs joints using Goniometer
3	Analysis of Range of Motion in different conditions using Electronic gonimeter
4	Volumetric analysis of irregular shaped body segments
5	Study of Stress Analysis on musculoskeletal system through simulation
6	Centre of Gravity Measurement using Reaction Board
7	Analysis of human motion using Movement Velocity counter
8	Study of myo electric activity using Electromyograph
9	Development of static human model using Visual 3D
10	Study of Joint articulation motion using Visual 3D
11	Analysis of walk and stance using Sports Models in Visual 3D
12	Study of blood flow using blood vessel models
13	Presentation on recent tropics in biomechanics
14	Presentation on recent topics in biomechanics
15	Revision of Practical
16	Project assessment and lab viva

Recommended Books:

- Susan J. Hall, Basic Bio-Mechanics, 5th Ed, 2007.
- Schnech Bronzino, Bio-Mechanics Principles and Application, 2008
- J. L. Meriam & L.G. Kraige, Engineering Mechanics, 6th ed, 2006.
- Pal, Subrata, Textbook of Biomechanics, 2009
- Peterson, Donald. R, Biomechanics principles & applications, 2008
- Asif Mahmood Mughal, Analytical Biomechanics-Modeling & Optimal Control, 2009
- Margareta Nordin, Victor H. Frankel, Basic Biomechanics of the Musculoskeletal System
- Peter M. McGinnis, Biomechanics of Sport and Exercise; Hardcover
- Nihat Özkaya, et al, Fundamentals of Biomechanics: Equilibrium, Motion, and Deformation
- David A. Winter, Biomechanics and Motor Control of Human Movement
- Frans Bosch, Ronald Klomp, Running: Biomechanics and Exercise Physiology in Practice
- Y. C. Fung, Biomechanics: Motion, Flow, Stress, and Growth
- Edward C. Benzel, Biomechanics of Spine Stabilization (Book with CD-ROM).

- Graham E. Caldwell, et al, Research Methods in Biomechanics

Title of the Course: EE-233 Digital Logic Design
Credit Hours: 2+1
Pre-requisites: Introduction to Computers

Specific Objectives of Course:

This course is a comprehensive study of the principles and techniques of modern digital systems. Digital design is the foundation of computer and microprocessor-based systems found in automobiles, industrial control system. The course is divided into two parts, combinational logic and sequential logic.

i) To provide the Students a basic understanding of the Digital logic design.
ii) To provide the student a pre-requisite background for future studies in microprocessors and microcomputer interfacing.
iii) To enable the students for developing exciting designs that they have always wondered about, but now can experience firsthand.

Course Outline:

Boolean Algebra and Boolean Operations: Introduction to Digital Electronics, Logic, Events and Binary Variables, Introduction to fundamental Boolean operations, NOT operation, OR operation, and AND operation, Truth Tables, Other Boolean operations as XOR, NOR, NAND, XNOR, truth tables, Boolean algebra, Boolean expressions, Boolean rules, DeMorgan's theorems, Two's complement of a binary number.
Logic Gates: Introduction to Digital Logic Gates, Symbols of Logic Gates, Positive Logic, Negative Logic, Implementing simple Boolean expressions with logic gates, Concept of universal gate, NAND gate as a universal gate, NOR gate as a universal gate. Logic Families.
Combinational Logic: Few examples of Combinational Logic including Half Adder, Full Adder, Parallel Adder, Parallel Adder Subtractor, Deriving sum-of-products (SOP) and product-of-sums (POS) expressions from a truth table, logic comparators. Reducing an expression using Boolean rules, Karnaugh map, Implementing logic circuits using Universal Gate, Hazard free design.
Code Converters: Encoders, Decoders, Binary Numbers to Grey Code converter, Grey Code to Binary Numbers Converter, 7-segment driver for common cathode displays and common anode displays, binary to BCD converter.
Sequential Logic Circuits: flip-flops, latches, counters, registers, clocks.
Integrated Digital Circuits: Multiplexers (MUX) and Demultiplexers, Read only memory, Kinds of ROM & RAM, Programmable logic arrays (PLAs), PAL devices, Implementing Combinational logic using Integrated Circuits
Displays: Seven-segment Displays, Common Anode Display, Common Cathode Display, Seven-Segment Display Driver, Dot Matrix Displays, LED and LCD displays, Drivers for displays.

Lab Outline:

Logic Gates, Sequential logic, Flip Flops, Counters, Latches, Registers,

Clocks, Display drivers, RAM, ROM, Multiplexers.

Recommended Books:

- M. Morris Mano, Digital Logic & Computer Design
- D. J. Comer, Digital Logic and State Machine Design, Oxford University Press.
- Victor P. Nelson, et al, Digital Logic Circuit Analysis and Design
- Brian Holdsworth, Clive Woods, Digital Logic Design, Fourth Edition
- M. Rafiquzzaman, Fundamentals of Digital Logic and Microcomputer Design, 5th Ed.
- Tocci, Ronald J, Digital Systems principles and application. 10th Ed, 2009.

Title of the Course: Signals & Systems

Credit Hours: 3+1
Pre-requisites: Circuit Analysis

Specific Objectives of Course:

To be familiar with kinds and characteristics of signals and systems, to learn mathematical representation of signals and systems, to have concepts on continuous-time, discrete-time, and sampled continuous-time signals to be able to perform time and frequency domain analysis of signals and systems, designing continuous-time filters, and to study concepts of impulse response and the system stability and the effects of sampling on signals

Course Outline:

Introduction, classification of signals, basic operations on signals, signal representation and models, system characteristics.

Time Domain Analysis: Sinusoidal and complex exponential signals, singularity function signals, signal energy and signal power, orthogonal signals, signal representation by generalized Fourier Series, continuous and discrete-time convolution evaluation and properties.

Frequency domain representation and analysis: Spectra and bandwidths of signals, Laplace Transform, Fourier series representation of signals, Fourier transform, energy density spectrum, power density spectrum, auto-correlation function, system frequency response, phase delay and group delay.

Continuous-time filters: Distortionless transmission, ideal filters, approximation of ideal filters, Butterworth and Chebyshev filter design.

Sampled Continuous – Time signals: Ideal sampling, Sampling theorem, practical sampling effects.

Frequency Domain representation of Discrete-time signals: Discrete-time Fourier series, discrete-time Fourier transform, Z-transforms and its properties.

Lab Outline:

Manipulating vectors and matrices
Generating Fundamental Signals
Performing basic time operations
Computing Even and Odd Parts of a signal
Performing Convolution and computing system output
Verifying Fourier Series
Verifying Fourier transform of some standard signal
Implementing Ideal Low Pass Filter using Inverse Fourier Transform
Designing and testing Butterworth filters
Designing and testing Chebyshev Filters
Verifying Spectra of Sampled Signals and Nyquist Theorem
Lab tutorial

Recommended Books:

- G. E. Carlson "Signals and Linear System Analysis", John Wiley & Sons, Inc., 2nd Ed, 1998
- S. Haykin, and B. V. Veen, "Signals and Systems", John Wiley & Sons, Inc, 2nd Ed, 2005.
- Oppenheim and Willsky, "Signals and Systems", Prentice Hall, 2nd Ed, 1996
- Northrop, Robert. B, Signals & systems analysis in biomedical Engg, 2nd Ed, 2010.

Title of the Course BM-323 **ELECTROMAGNETISM**

Theory Cr Hrs **2+0**
Pre-requisites: Applied Physics

Objectives:

To have basic concepts in Electro-statics and electromagnetism, to give understanding of the principles of electromagnetism that are fundamental to biomedical sensors and equipment.

Course Outline:

Vector Analysis, Dot and Cross products, divergence, curl and gradients, Electric Field Intensity, Flux Density, Energy and Potential, Energy Stored in Electric Fields, Electric Fields in Material Media, Gauss's Law, Gradient, Divergence and Curl, Stokes theorem, Boundary Conditions, Poisson's and Laplace Equations, Point Form of Ohm's Law, Permitivity, Calculation of Resistance and Capacitance, Steady Currents & Magnetic field, Magentization and Permeability, Inductance and mutual inductance, Magnetic Flux Density, Line Charge Density, Surface Charge Density, Volume Charge Density, Biot-Savart Law, Lorentz's Force Law, Magnetic Field in Material Media

Recommended Books:

- Engineering Electromagnetics, William Hayt, McGraw Hill, 7th Edition, 2010.
- Elements of Eletromagnetics, Sadiku Mathew, Oxford University Press.
- Electromagectics, J. D. Kraus, 5th Edition, McGraw-Hill, 2005.

Title of the Course: **BS-346** **Probability & Statistics**
Credit Hours: 2+0
Pre-requisites:

Specific Objectives of Course:

This subject aims to model discrete-time signals as random signals originating from some random process such as those occurring in a biomedical system. The subject covers fundamentals of probability theory and makes the student familiar with probability distributions and statistical characteristics of a random signal.

Course Outline:

Descriptive Statistics: Basic definitions, Measures of central tendency and variation, Chebychev's theorem, z-scores, Frequency distribution, Graphical representation of data stem & Leaf and Box Plots, Symmetry and skewness, Quintiles (Percentiles, Deciles & Quartiles)

Probability Theory: Basic definition and rules of probability, Conditional probability & Bayes's Theorem, Counting techniques.

Random Variable: Concept of random variable, Discrete & Continuous random variable and its random variable and variance of random variable and their properties.

Discrete & Continuous Probability Distributions: Uniform, Binomial, Multinomial, Hyper geometric, Negative binomial, Geometric, Poisson, Normal & Exponential distributions and their applications.

Sampling Theory: Sampling distribution of mean, t-distribution, and Sampling procedures.

Regression & Correlation: Linear, Exponential and Multiple Regression Models and Multiple Correlation Coefficient, ANOVA.

Statistical Inference: Estimation of parameters such as mean and variance, Classical and Bayesian method of estimation.

Hypothesis Testing: Z-test, t-test, and Goodness of fit test.

Recommended Books:

- Byron Wm. Brown, Myles, Statistics: A Biomedical Introduction (Wiley Series in Probability and Statistics)

- Morris H. DeGroot, Mark J. Schervish, Probability and Statistics (3rd Edition)
- Murray R Spiegel, et al, Schaum's Outline of Probability and Statistics
- Jay L. Devore, Probability and Statistics for Engineering and the Sciences (with CD-ROM and InfoTrac)
- Daniel Wayne , Biostatistics basic concept and methodology for the health science 9th Ed, 2010
- Indrayan , Medical Biostatistics 2nd Ed, 2008
- Marcello, Pagano., Principles of Biostatistics, 2nd Ed, 2000.
- Steven Kay, Intitutive Probability and Random processes using MATLAB, 2006.
- Cooper & McGillem, Probabilistic Method of Signal and System Analysis,

Title of the Course: CS-321 Microprocessor & Interfacing
Credit Hours: 2+1
Pre-requisites: Digital Logic Design

Specific Objectives of Course:

The developments of Microprocessor Technology are taking place at the tremendous pace. Keeping this in mind the contents of this subjects aims to introduce range of 8-bit & 16-bit microprocessors including historical evaluation & revolution, Architecture, Programing & Interfacing.

i) Simplified architecture, 8085, 8600 and 8086 microprocessors and their organization.
ii) Programing techniques.
iii) Interrupts.
iv) Interfacing the microprocessor to out side the world.

Course Outline:

Introduction to Micro processors: Digital systems, SAP architecture and its model.

8/16-Bit Micro Processors: Introduction to 8085/6800/8088/8086 processors, architecture, memory & processor.
8088 Hardware Specifications: Pin-outs & pin functions, clock generator (8284A), bus buffering & latching, bus timing, minimum mode versus maximum mode.

Interfacing Techniques: Memory interfaces, basic I/O interface, programmable keyboard/ display controller 8279, programmable interval counter 8254 serial, 8088 interfacing, interrupt structure, case studies of interfacing with medical equipment.

Programming model of 8088: Data formats, instruction set of 8088, addressing modes, data movement instructions, Arithmetic & logic instructions, program control instructions.

Lab Outline:

Single instruction execution, use of MAT Trainer, Assembly Language Programming using DEBUG & MASM Assembler, Interfacing with PC applications.

Recommended Books:

- Chowdhry B. S, MK Kella, AR Memon & AQK Rajput, CompuPedia: The art of living with Computer Technology, Published by Mehran Infotech Consultants, Hyderabad, ISBN: 969-8680-05-5
- Raj Kamal, Embeded System Architecture Programing And Design
- John Uffenbeekm, The 80x86 Family Design, Programming And Interfacing.
- Avtar Singh and Walter Triebel, The 8086 and 80286 Microprocessor,
- Englewood Cliffs, N. J., Hardware, Software, and Interfacing. Prentice Hall.
- Barry B. Barry, The Intel Microprocessor.
- Jon Haych, Computer Arch Org. & Design.
- Charles M, Gilmore, Microprocessor Principles and Applications, McGraw Hill.
- Douglas V. Hall, Microprocessors and Interfacing: Programming and Hardware, Prentice Hall.

Title of the Course: BM-341 **Bioinstrumentation-I**

Credit Hours: 3+1

Pre-requisites: Biomedical Electronics

Specific Objectives of Course:

This course deals with the medical instrumentation application & design. It describes the principles, applications & design of the medical instruments commonly used in hospitals. In view of technology innovation with time the course shall be designed to focus on fundamental principles of operation on general types of equipment avoiding detailed descriptions of specific models. Since Biomedical Engineering is an interdisciplinary field, requiring good communication with health care personnel's as well the course provides applications on each type of equipment. Having completed this course ,the students will be able to cover working principle, building blocks of circuit involved in each equipment & systems added with the measurement, analysis of bio-potentials, biomedical transducer characteristics , electrical safety, applications of advanced integrated circuits, operational amplifiers for signal processing & computer interfacing & signal analysis for display on the computer.

Course Outline:

Introduction: Precision, resolution, sensitivity, accuracy, uncertainty, Principles & development of Biomedical Instrumentation, Problems encountered in living systems.

Biological Systems: Study of various Physiological systems, related biopotentials and physiological parameters.

Diagnostic Equipment: invasive and noninvasive measurement

techniques and related equipment.
Cardiovascular Measurements: Electrocardiography, Measurement of Blood pressure, Blood flow and Cardiac output.
Biomedical Sensors & Transducers: Introduction, principles, theory, design and applications, Principles and design, Speed, Position, Temperature, light & Pressure transducers, Programmable logic controller, PLC interfacing, memory processor.
Patient Monitoring Equipment: Patient Monitors, central monitoring system, telemetry system, Gas Exchange and distributions, Respiratory therapy equipment.
Therapic Equipment: ventilator, inhaler, defibrillator, pacemaker and heart lung machines.
Radiological Equipment: concept of ionization and nonionization radiation and related equipment, medical lasers and applications.
Safety in Medical Equipment: Electrical/Mechanical safety, Standards of Medical Devices, Biohazards and Safety Regulations.

Quality Assurance and Quality Control: Calibration, maintenance and reparability of monitoring equipment.

Lab Outline:

Biological Transducers, Measurement of Biomedical Signals, ECG, EMG Recorders, Respiratory equipment, Therapeutic equipment, X-ray tube Model, Biotelemetry Components, Electrical Safety Analyzer.

Recommended Books:

- Cromwell, Bio-Medical Instrumentation & Measures 2nd ed.
- Walter Welhowitz, Sid Deutsch and Metin Alsey, Biomedical Instruments: Theory & Design, Academic Press, Inc.
- R. S. Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill Publishing Co.
- Hauptmarn, P., Sensors Principles and Applications Prentice Hall.
- John G. Webster, Bioinstrumentation, 2003.
- John G. Webster, Medical Instrumentation: Application and Design, 4th Ed, 2009.
- Donald L. Wise, Bioinstrumentation and Biosensors
- Richard Normann, Principles of Bioinstrumentation
- Donald L. Wise (Editor), Bioinstrumentation: Research, Developments and Applications,

Title of the Course: Islamic Studies

Annexure "D"

Title of the Course: Social Sciences

Annexure "B"

Title of the Course: BM-361 Bio-Signal Processing
Credit Hours: 2+1
Pre-requisites: Signals & Systems, Probability & Statistics

Specific Objectives of Course:

To provide a good foundation of the fundamentals of digital signal processing and its application to biomedical signal processing.
To develop a thorough understanding of filtering concepts and their specific design and implementation in the biomedical SP context.
To able the students to implement DSP algorithms in MATLAB and apply to ECG signals. To develop a basic understating of features and their extraction from biomedical signals.

Course Outline:

Review of signals and systems and their properties, Modeling of Dynamic Systems, Linear Constant Coefficients Differential Equation (LCCDE) and Difference Equation, Review of Laplace transform, Transfer Function, Poles and Zeros, Sampling and Reconstruction, up-sampling and down sampling, Z-transform and its application in the analysis of Discrete LTI system, computation of frequency response from Pole, Zero plot, Review of the Frequency domain analysis of Continuous time systems, CTFS, CTFT, DTFT, DFT (DTFS), FFT, Design and implementation of analog and digital finite impulse response (FIR) and infinite impulse response (IIR) filters. A quick introduction to statistical signal processing, feature extraction and pattern recognition techniques, Case Studies of various Biomedical Signals: ECG, EEG

Lab Outline:

Introduction to MATLAB Signal Processing Tool Box
Signal generation, convolution, impulse response
Up- Down- Sampling
Spectral Leakage and Zero Padding
Introduction to Simulink
Sampling and Reconstruction through Simulink
Frequency Response of Discrete Time Systems
Implementation of FFT DIT algorithm in MATKAB
Design and Implementation of LP, HP filter
Design and Implementation of BP filters
Data classification
ECG acquisition and introduction MIT/BIH arrhythmia database
QRS Detection: Pan-Tompkins Algorithm Part I
QRS Detection: Pan-Tompkins Algorithm Part I
ECG Rhythm Analysis

Recommended Books:

- A. B. Carson, Signals and System, Wiley, 2003
- John G. Proakis, Dimitris, Digital Signal Processing 2nd & 3rd Ed.
- Engene, N, Bruce, Biomedical Signal Processing and Signal Modeling, 2001, John Wiley & Sons.
- Arther, B. Ritter, Stanley Reisman & Bozena, B. Michniah, Biomedical

Engineering Principles, CRC Taylor & Francis
- John L. Semmlow, Biosignal and Biomedical Image Processing (Signal Processing)
- Saeed V. Vaseghi, Communications, Advanced Digital Signal Processing and Noise Reduction
- Charles C. Hsu (Editor), Charles Hsu, Advanced Signal Processing Technology
- Allan V Oppenheim, Digital Signal Processing, Prentice Hall

Title of the Course: English-III

Annexure ."A"

Title of the Course: BM-342 Bio-Instrumentation-II
Credit Hours: 3+1
Pre-requisites: Bio-Instrumentation-I

Specific Objectives of Course:

To understand the working principle of the Laboratory Instrumentation found in hospital or Clinical Diagnostic Laboratories.
Having completed this course, Students are covered the biomedical application in clinical laboratories, Understand the different diagnosis techniques which are involved in Laboratory equipment

Course Outline:

Microscopy: Electron Microscopy, Atomic Force Microscopy, Confocal Microscopy.

Spectroscopy: U. V., I. R., NMR & Visible Absorption, Flourometric Methods, Flame Photometry, Spectrographic Spectroscopy, Circular Dichroism, Mass Spectrometry.

Electrochemical methods of analysis: Electrophoresis Chromatography, High Performance Liquid Chromatography, Clinical Chemistry Analysis, Study of different blood components through automated cell-counter, Centrifuging Techniques, Blood Banking and Transfusion, Service Automation, Polymerase Chain Reaction.

LAB OUTLINE:

S. No	TITLE OF PRACTICALS
1.	To study electronics & determination of pK by pH meter
2.	Confirmation of the tyrosine by Spectrophotometer
3.	Designing of Spectrophotometer
4.	Separation of Proteins by electrophoresis
5.	Separation of serum from blood samples by centrifuge
6.	Designing of Centrifuge
7.	To find out the fluorescence of vitamins (Riboflavin) by Spectrophotometer
8.	To determine the Rf value of amino acids by Paper Chromatography
9.	separation / Estimation of Neurotransmitter by HPLC

10. Determination of Na+ & K+ from the biological samples by flame photometer (Flame photometer)
11. To observe the graphical views and analysis of the pH of the different samples solution by using Power lab
12. Analysis of blood by Automated chemistry Analyzer
13. Estimation of blood cells by Automated hematology system
14. Measurement of Hematocrit values by Automated hematology system
15. To study U.V and visible spectra of Proteins/nucleic acid/Riboflavin by Automated Spectrophotometer
16. Seminar / Presentation of different equipment

Recommended Books:

- John G. Webster, Bioinstrumentation, 2003
- John G. Webster, Medical Instrumentation: Application and Design, 4th Ed, 2009.
- Bengt Nolting, Methods in Modern Physics
- Cromwell, Bio-Medical Instrumentation & Measures 2nd Ed.
- I.D. Campbell & Ragmod A. Dwel, Biological Spectroscopy. The Benjamin Publications.
- Ramrit Sood, Medical Laboratory Technology: Methods and Interpretations, 2003, Jaypee Brothers, New Delhi.
- Leslie Cromwell, Fred J. Weiball and Erich, A. Pleiffer, Biomedical Instrumentation and Measurements, Prentice Hall , India
- Joseph, J. Carr, John, M. Brown, Introduction to Biomedical Equipment Technology, Prentice Hall Career & Technology.
- Mary C. Haven (Editor), et al, Laboratory Instrumentation
- James W. Dally, William, Instrumentation For Engineering Measurements-2nd Ed.

Title of the Course: BM-351 Biomedical Control Systems

Credit Hours: 2+1
Pre-requisites: Signals and Systems

Specific Objectives of Course:

After completion of this course, students should be able to:

i) Derive mathematical methods of simple physical systems.
ii) Represent control systems using block diagrams, block diagrams and state space representation.
iii) Perform transient and steady state analysis.
iv) Construct Bode diagram, Nyquist plots and Nichols charts. Check stability, controllability and obervability of control systems.

Course Outline:

Introduction: Introduction to Control Systems, Open – loop and closed – loop systems and their transfer functions, block diagrams, signal flow graphs.

Modeling of Physical Systems: Importance of modeling. Formation of differential equations of electrical, mechanical, electromechanical and

other systems. Modeling of human systems.
Transient Response: Poles and zeros of a transfer function, stability, standardized inputs, steady – state and transient response of first – order, second order and higher order systems. Transient response specifications in time and frequency domain.

State-Space Representation and Analysis: Introduction to state space concepts and terminology, formation of state and output equations for physical systems. Solution of state equations, Eigenvalues and Eigen vectors, state – transition and transfer function matrices.

Steady-State Response: Types and analysis of feedback control systems based on steady-state error coefficients, sensitivity function.

Time Domain Analysis: Root locus diagrams, Analysis and Design of Control Systems Based on Root locus technique.

Frequency Domain Analysis: Routh-Herwitz Stability criterion, Bode plots, Polar plots, Nyquist stability criterion, Gain and phase margins, Nichol's chart.
Application of principles of control theory to analysis of biological system development of computer simulations techniques to study dynamic response of physiological system.

Recommended Books:

- Charles S. Lessard, Basic feedback control in biomedicine, 2009
- Micheal C. Khoo, Physiological control systems.
- K. Ogatta, Modern Control Engineering, Prentice Hall.
- Stefni, Savant Shahan and Hosteller, Design of Feedback Control System, Oxford University Press.
- Richard C. Dorf, Modern Control System
- Zhou, Essentials of Robust Control- 1st –Ed
- W.E. Snyder, Industrial Robots-Computer interface and Control, Prentice-Hall.
- Malcolm, Robotics- an Introduction, Breton publishers.
- Design of Feedback Control System, Stefni, Savant Shahan and Hosteller, Oxford University Press.
- Asif Mahmood Mughal, Analytical Biomechanics – Modeling & Optimal Control, 2009

Title of the Course: CS-331 Modeling & Simulation

Credit Hours: 2+1
Pre-requisites: Physiology-II, Biomechanics

Objectives:

The vital organs are complex entities that are regulated by many factors including chemical, biological, and mechanical, etc. To have a better understanding of the interactions between these factors and resulting phenomena, a thorough analysis is necessary of all possible data that can be collected. The main focus will be on human vital organs, mechanical behavior of subsystem, and simulation in Biomedicine and the affecting factors.

Course Outline:

Introduction, Basics of modeling and simulation, Examples and investigations of simulations in real system, Concept of modeling in Biomedical Engineering and realization of models in simulation systems. Definition of terminologies used in modeling and simulation, Discuss queuing theory (examples, why queues form and waiting lines), Describe components of a basic queuing process, Configuration of the service system, Digital simulation and mathematical modeling, Time-oriented and event-driven processes, A brief overview of the variety of mathematical models, Model of cardiorespiratory system (model requirements, conceptual model), Model of circulatory system (model requirements, conceptual and mathematical model), Model of respiratory system (model requirements, multiple/conceptual/ mathematical models), Physiological control modeling (model requirements/conceptual/ mathematical models), Applications of modeling of liver, heart and lungs.

Lab Outline:

Modeling of biological systems using software like MATLAB, Mathematica, Ansys, Maple, 20-Sim and Fluent etc. Modeling and simulation of ODEs, dynamic systems using physical laws. Simulation of first and higher order models, Simulations of application specific models.

Recommended Books:

- Willem van Meurs, Modeling and Simulation in Biomedical Engineering, 2011
- Moon, Todd K., Mathematical Methods & Algorithms Signal Processing (With Cd).
- Frank C. Hoppensteadt, Charles S. Peskin, Modeling and Simulation in Medicine and the Life Sciences.
- Hartmut Bossel, Modeling and Simulation.
- Bernard P. Zeigler, et al, Theory of Modeling and Simulation.
- Stanislaw Raczynski, Modeling and Simulation: The Computer Science of Illusion (RSP Bird).
- D. C. Karnopp, R. Rosenberg & Margolis, Systems Dynamics-Introduction to Mechatronics Systems, 2006.

Title of the Course: **BM-362 .Economics & Healthcare Management**

Credit Hours: 3+0

Pre-requisites: None

Specific Objectives of Course:

The module/programme is designed to equip biomedical engineers to enhance their ability to influence, manage and achieve work-based objectives within a sound financial framework.

i) To understand Basic concepts of economics, finance, and market supply & demand.

ii) To provide the opportunity for clinicians, managers and others to direct their education toward the field of advanced management with

the help of IT.

iii) To provide an education that is both intellectually challenging and directly relevant to the field of health care management.

iv) To deliver an educational programme which is designed to provide participants with concepts, models, techniques and examples relevant to health care management, which will enable them to improve the provision of health care delivery to patients.

Course Outline:

Introduction: Basic concepts of economics, accounting, cost benefit ratios, interpretation of financial statements, supply and demands. Types of markets, Forecasting.

Health care Systems: Hospital Organizational Structure, Healthcare Economics, Hospital Information Flow and Handling, HMIS, HIMS. Safety Programs.

Equipment Management System: Acquisition, Control program, Predictive and Preventive maintenance, repair Facilities.

Management and Supervision: Concept, principles and functions of Hospital management. Legal, Professional and Ethical Aspects, Resources, Duties & functions of administrative (medical & paramedical) staff. Planning, Knowledge of various Hospital services.

Lab Outline: N/A

Recommended Books:

- Kaluzny, Warner, Warren, Zelman, Management of Health Services
- Joseph J. Carr, John M. Domach, Introduction To Biomedical Equipment Technology 4th Ed
- Cimino, James J, Biomedical informatics computer applications in health care & biomedical, 2008.
- Sakharkar Sharon B, Principles of hospital administration & planning, 2009.
- Buchbinder Sharon, Introduction to health care management 2007.
- Susan Penner, Introduction to Health Care Economics and Financial Management: Fundamental Concepts with Practical Application
- William N. Zelman, et al, Financial Management of Health Care Organizations: An Introduction to Fundamental Tools, Concepts, and Applications
- Ann Clewer, David Perkins, Economics for health care management Shahram Heshmat, An Overview of Managerial Economics in the Health Care System (Delmar Series in Health Services Administration)

Title of the Course: BM-471 Biomaterials & Design

Credit Hours: 3+1

Pre-requisites: Biomechanics, Physiology, Physiology II

Specific Objectives of Course:

The course in aimed at studying materials and their biomedical applications.

The course is framed at studying material properties as criteria to compare the materials, their applications, the issues of bio compatibility and logic cycle of implants.

Course Outline:

Biomaterials Science and Review: Hard Tissues and Pathologies, Orthopaedic prostheses, Properties of Natural Tissue Replacements.
Biopolymers and Biomaterials: 3D structure of Biopolymers by Bio X-ray diffraction, Biomedical application of chitosan and other Biopolymers, Structure property relationships, Metals – Dental Implants, Bioceramics and Composites
Biocompatibility: Immune System, Corrosion, Deterioration of Non-metallic Materials, Mechanical Factors, Testing of Biomaterials.
Applications: Joint Replacements, Fracture Fixation, Soft Tissue Implants, Vascular Implants, Tissue Engineering; Gene Therapy using viral vectors, Materials for Scaffolding.

LAB OUTLINE:

S. No	TITLE OF PRACTICALS

1. To build molecular model of a biopolymer from basic repeating peptide units
2. Molecular graphics of basic repeating units of biopolymer
3. Interpretation of bio X-ray diffraction of a biomaterial expected diffraction pattern
4. Calculate R-value for structural analysis of biopolymers
5. Presentation/seminar
6. To built model of CHITOSAN (bio-materials) from basic repeating units.
7. Molecular graphics of basic repeating units of CHITOSAN.
8. Demonstration of features of dental chair & dental operatory.
9. Demonstration of bio-materials (bioceramics, porcelain & metals) its composition & properties
10. Presentation Seminar.
11. Demonstration of the process of sterilization, autoclave & X-ray unit (dental).
12. Separation of bio-material (protein) by electrophoresis method involved in various diseases.
13. Demonstration of different types of sutures.
14. Presentation / seminar.

Recommended Books:

- Michael N. Helmus (Editor), Biomaterials in the Design and Reliability of Medical Devices
- David Hill, Design Engineering of Biomaterials for Medical Devices
- Buddy D. Ratner, et al, Biomaterials Science, Second Edition: An Introduction to Materials in Medicine
- Jos Vander Sloten (Editor), Computer Technology in Biomaterials Science and Engineering (Biomaterials Science & Engineering)
- Kay C. Dee, et al, An Introduction to Tissue-Biomaterial Interactions
- Rolando Barbucci (Editor), Integrated Biomaterials Science

- Joon B. Park, Joseph D. Bronzino, Biomaterials Principles and Application
- William, D. Callister Jr., Material Science & Engineering, 2003, John Wiley & Sons.
- Park Joon B., Biomaterials: Principles And Applications
- IEE Publication (Section IV, Biomaterials 40 to 48 and193 Regulation of Biomaterials),
- Bhat, Sujata.V, Biomaterials 2nd Ed, 2005.
- Xian, Wujing, A laboratory course in biomaterials, 2009.
- Mahapatro, Anil, Polymers for biomedical applications, 2008.
- Temenoff, J. S, Biomaterials: The intersection of biology & materials science, 2008.

Title of the Course: BM-499 Neuroscience & Neural Networks

Credit Hours: 3+1

Pre-requisites: Physiology-II, Digital Logic Design

Specific Objectives of Course:

The objective of the course is to provide an understanding of mechanism involved in the transformation of information in the brain. Various brain regions are associated with specific function. Modulation of transmission by devices can help to modulate brain function and the treatment of brain disorders related to that brain region.

Course Outline:

Introduction to neuroscience: nervous system, sympathetic, parasympathetic and motor nervous system and their functions, brain and its functions. Neurons and glia, structure of a neuronal cell, types of glia, blood brain barriers.

Signaling in the brain: electrical excitability of neurons, resting membrane potential, action potential, intra neuronal singling, inter neuronal singling. Synaptic events, chemical messengers, synaptic transmission.

Receptors: Ionotropic and metabotropic receptors, signal transduction pathways, G-proteins, protein phosphorylation. Signaling to the nucleus, regulation of gene expression.

Neurotransmitters: Excitatory and inhibitory amino acid neurotransmitters and functions in the brain, role of excitatory neurotransmitter in learning and memory. Diseases associated with the malfunctioning of these neurotransmitters.

Catecholamines: functions in the brain, Diseases associated with the malfunctioning.

Artificial Neural Network: Model of single neuron, neural network architectures. Feed forward neural networks. Multilayer perception, back propagation algorithm, radial basis function networks. Unsupervised learning. Hopfield network, self organizing map, other unsupervised networks. Reinforcement learning.

Lab Outline:

Study of brain parts and its function. Mcculloch pitts neural network architecture and its implementation, Mcculloch pitts neural network in logical circuits designing (AND, NAND, OR, NOR, NOT), Designing and plotting of transfer functions using MATLAB, Perception learning (Supervised training), Perceptron training using neural network toolbox, checking necessary conditions of Hebb's Rule (Orthonormality), hebb's Rule, Pseudo Inverse Rule.

Recommended Books:

- S. Haykin. Neural Networks- A comprehensive Foundation,, McMillan Co. 2003.
- Roman, R. Poznanski, Biophysical Neural Networks: Foundations of Integrative Neuroscience, 2001.
- Progress in Neuroscience, Readings from Scientific American, John Wiley.
- Philip, G. Srauge, Brain Biochemistry and Brain Disorders, Oxford Press.
- George, J. Siegal, B. W. Agranoff, S. K. fisher , M. D. Uhler, Basic Neurochemistry: Molecular, Cellular and Medical Aspects, Lippincott D. Uhler.
- Winston Artificial Intelligence: Addison-Wesley
- Neural Circuits & Networks, NATO Advanced Study Institute on Neuronal Circuits and Networks, et al
- Christopher M. Bishop, Neural Networks for Pattern Recognition
- Bart Kosko, Neural Networks and Fuzzy Systems: A Dynamical Systems Approach to Machine Intelligence/Book and Disk
- Brian D. Ripley, Pattern Recognition and Neural Networks
- Darakhshan Haleem, Neurochemistry, Neuropharmacology and Behavior, 2010.
- Mark F. Bear, Barry W. Connors & Michael A. Paradiso, Neuroscience: Exploring the brain, 2006

Title of the Course: BM 481 Medical Imaging

Credit Hours: 2+1
Pre-requisites: None

Specific Objectives of Course:

The main aim of this course in bio-medical engineering is to let the student know the basic physical principles involved in all imaging techniques.
The object is to let the student understand the operation, construction and function of each imaging equipment.

Course Outline:

Introduction: Interaction of Radiation with Matter, Scattered & absorbed Radiation, spatial image formation.

Imaging Transducers: Various transducers used in medical imaging systems.

Imaging development: X-ray Film, Fluoroscopic imaging, Digital Imaging System, X-ray imaging, Film-less radiographic imaging, CT imaging, Emission Tomography imaging, Nuclear imaging, MR Imaging, Functional MRI imaging , Advance imaging modalities like PET and SPECT. Emerging areas in medical imaging.

Ultrasound Imaging: Ultrasonic imaging, Doppler Imaging, software based estimations and measurement in ultrasonic imaging. Planar and Volumetric analysis techniques.

Medical imaging software: Algorithms, techniques, imaging archival and management. Molecular imaging and other advance biomedical imaging techniques and their image manipulation.

Quality Assurance and Control in Medical Imaging **Equipment**: Quality assurance of medical imaging, Evaluation of imaging parameter and related equipment calibration, Diagnostic values, Statistical performance measures.

LAB OUTLINE:

S. No	**TITLE OF PRACTICALS**

1. Demonstration of X-rays Equipment.
2. Ultrasound of liver and Gallbladder
3. Ultrasound of spleen
4. Ultrasound of kidney
5. Ultrasound of pancreas
6. Introduction, Technicalities, MATLAB
7. Histograms and Morphological Operators on X-rays
8. Intensity Transformation using MATLAB
9. DFT and Spatial Filtrating using MATLAB of medical Images
10. Filtrating in frequency Domain of medical Images (MRI/CT)
11. Image restoration of Medical Images (MRI/CT)
12. Image Compression of Medical Images (MRI/CT)
13. Demonstration of NMR

Recommended Books:

- Bushberg & Bushong, Physics of Medical Imaging.
- Bushberg J.T., The Essential Physics of Medical Imaging 2nd Ed.
- Z. H. Cho, Foundations of Medical Imaging.
- Atamdhawan, Medical Image Analysis.
- Buxton, Richard B, Introduction To Functional Magnetic Resonance Imaging: Principles And Techniques.
- Murdy, Karen M., Biomedical Imaging (Principles & Application Engg: Series).
- Andrew G. Webb, Introduction to Biomedical Imaging (IEEE Press Series on Biomedical Richard A. Robb, Engineering) Biomedical Imaging, Visualization, and Analysis.
- Karen M. Mudry (Editor), et al, Biomedical Imaging (Principles and Applications in Engineering, 10).
- Richard A. Robb, Three-Dimensional Biomedical Imaging: Principles

and Practice.
- Nick Van Bruggen (Editor), Timothy Roberts (Editor), Biomedical Imaging in Experimental Neuroscience.

Title of the Course: BM-486 Power Electronics
Credit Hours: 3+1
Pre-requisites: Electronic Circuit Design

Depth Course of Power electronics to introduce the concepts of power semiconductors, thristors, inverters, choppers, rectifiers etc. This course will also emphasize on their applications in biomedical devices and instrumentation.

Course Outline:

Power Semiconductor Devices: Power Diodes, Power Transistor, Thyristors, Multilayer Devices, Multilayer Devices.
Firing, Commutating and Protecting Circuits: Thyristor Turn-on Methods, Devices Used for Firing Circuits, Gate Characteristic of Thyristor
Controlled & Uncontrolled Rectifiers: Half-Wave Rectifier, Full-Wave Rectifier, Three-Phase Rectifiers

Inverters: Principle of Voltage-Driven Inversion, Principle of Current-Driven Inversion, Sine Wave Inverter, Square Wave Inverter, Three-Phase Inverter.

Choppers: Chopper Classification, Thyristor Choppers with Commutated Circuits, DC-DC Switch Mode Regulator, DC-DC Switch Mode Regulator with Isolation

AC Voltage Controllers and Cycloconverters: Phase-Angle Controller, Cycloconverters

Applications of Power Electronics: Solid-State Switching Circuits, Power Supply, Motor Drive

LAB OUTLINE:

S. No	TITLE OF PRACTICALS
1	Familiarize with various power semiconductor devices (SCR, DIAC,TRIAC, UJT)
2	To study the transistor model of SCR and measure the anode current (I^) gate current (IG**)** and cathode current (IK) and voltage b/w the bases of the two transistors (VGG)
3	Measure the Holding Current IH, Latching IL, and Gate IG Current of Thyristor
4	Determine the DC gate Current required to turn on the SCR using DC Gate control and DC anode source
5	Measure the peak positive amplitude of the waveform, the load current it, the gate current IG, and the conduction angle by using DC Gate control and AC anode source
6	Measure the peak positive amplitude of the waveform, the load current

it, the gate current IG, and the conduction angle by using DC Gate control and AC anode source

7 An UJT relaxation oscillator for triggering an SCR
8 Write a program in PSPICE for a half wave controlled rectifier with the inductive load. Observe and draw the output voltage, output current, Gate pulse and voltage across the thyristor waveforms
9 Write a program in PSPICE for a half wave controlled rectifier with the inductive load. Observe and draw the output voltage, output current, Gate pulse and voltage across the thyristor waveforms.
10 Write a program in PSPICE for a half wave controlled rectifier with the inductive load. Observe and draw the output voltage, output current, Gate pulse and voltage across the thyristor waveforms
11 Write a program in PSPICE for a half wave controlled rectifier with the inductive load. Observe and draw the output voltage, output current, Gate pulse and voltage across the thyristor waveforms
12 DC Choppers
13 To study the operation of an SCR automatic speed control circuit
14 Biomedical transducers
15 Revision
16 Final Viva

Recommended Books:

- A. S. Sedra & K.C. Smith. Microelectronic Circuits, Oxford University Press.
- Togawa, Tatsuo, Biomedical Tranceduces & Instruments
- Power Electronics and Its Applications Book by Alok Jain

Title of the Course: **Biomedical Engineering Project**
Credit Hours: 0+6
Pre-requisites:

Title of the Course: **Professional practices**
Credit Hours: 3+0
Pre-requisites:

SCHEME OF STUDIES
MS (2-Year) in Bio-Medical Engineering

Semester	Course Code	Subjects	Credits
First	BM-501	Core-I	3
	BS-501	Core-II	3
	BM 5XX	Elective-I	3
		Total	**9**
Second	BM-502	Core-III	3
	BM-513	Core-IV	3
	BM-5XX	Elective-II	3
		Total	**9**
Third	BM-6XX	Elective-III	3
	BM-6XX	Elective-IV	3
	BM-699	Master Thesis	3
		Total	**9**
Fourth	BM-699	Master Thesis	3
		Total	**30**

The department may offer core/elective courses from the given list but not limited this list according to the availability of resources.

Suggested List of Core Courses

BM 501 Modeling & Simulation of Physiological Systems
BM 502 Research Methodology
BM 503 Advanced Biomedical Signals & Systems
BM 504 Biomedical Engineering Design
BM 505 Finite Element Methods
BM 506 Mechatronics System Design
BM 507 Experimental Biomechanics
BM 508 Advanced Biomedical Control Systems
BM 509 Advanced Biomedical Instrumentation
BM 510 Biomedical Ethics

Suggested List of Elective Courses

BM 521 Advanced Clinical Instrumentation
BM 522 Design of Medical Devices
BM 523 Embedded Systems & Applications
BM 524 Medical Microsystems
BM 525 Biomaterial Science & Engineering
BM 526 Rehabilitation Engineering
BM 527 Cell and Molecular Biology
BM 528 Bioelectromagnetism
BM 529 Ultra Power Electronics
BM 530 Medical Informatics
BM 531 Telemedicine System

BM 532 Computational Biomechanics
BM 533 Advanced Computational Biology
BM-534 Computer Vision
BM-535 Medical Robotics
BM-536 Prosthetics & Orthotics
BM-537 Clinical Gait Analysis
BM-538 Advanced Biochemistry
BM-539 Drug Delivery & Pharmacology
BM 621 Advanced Bio-Fluid Mechanics
BM 622 Tissue & Cell Engineering
BM 623 Medical Image Processing
BM 624 Advanced Medical Imaging
BM 625 Pattern Recognition
BM 626 Biomaterials and Drug Delivery
BM 627 Injury Mechanics
BM-628 Design of Implants/Artificial Organs
BM-629 Advanced Biomechanics
BM-630 Cardiovascular Fluid Mechanics
BM-631 Structural Bioinformatics
BM-632 Functional Genomics
BM-633 Proteomics
BM-634 Adaptive Signals and Filter Design
BM-635 Advanced Mass Transfer

DETAIL OF COURSES FOR MS (2-Year) IN BIOMEDICAL ENGINEERING

Core Courses

BM-501 Modeling & Simulation of Physiological Systems 3 C.hr.

Introduction: Model Human, an engineering point of View, mathematical Model, types and variation of models.

Cell Physiology and transport: Gibbs-donnan Equilibrium, Carrier Mediated Transport action potential, Energetics of Muscle Contraction.

Motion: Electrical analogy of steady Flow, Newton law of viscosity, Laminar flow and Viscosity of Blood, general form of equation of motion, sheer stress and endothelial cells.

Signal Processing: Overview, signal acquisition and it's processing.

Human Modeling: Techniques for Physiological system, Autoregressive modeling, time frequency analysis, physiology of autonomic nervous system and heart rate variability, Measurement of Physiological stress, cardiac rhythm, EMG and Its spectral analysis and mean power frequency , and EEG and Its spectral analysis & coherence. Modeling the respiratory System

Recommended Books:

- Donald R. Cooper, Pamela S. Chridler, Business Research Methods, Irwin McGraw Hill.
- Arlene Finch, Conducting Research Literature Reviews, Sage Publications
- John W. Creswell, Research Design: Quantitative & Qualitative Approaches, Sage Publications.

BM-502 Advanced Biomedical Signals and Systems 3 C.hr.

Introduction: Origins of biomedical signals, challenges in acquisition and interpretation, time and frequency domain representation, Filter Design and applications,
Random Signals: Random signals and stochastic processes, parametric and nonparametric estimation of power spectral density; case studies:
Instrumentation: Signal acquisition, analysis and interpretation in a hospital, diagnostic laboratory. Time-frequency and time-scale analysis of biomedical signals, case studies. Adaptive processing of biomedical signals and applications. Emerging techniques in medical signal processing. Case studies: EEG/EMG and evoked potentials.

Recommended Books:

- Joseph, D. Bronzino, Medical Devices and Systems, 3rd Ed. 2006.

BM-513 Biomedical Engineering Design 3 C.hr.

Introduction: Principles of Electronic Instrumentation, Biopotential measurements, Electrical and Electronic device design for Biomedical Engineering; laboratory experience designing devices for taking measurements of living systems.
Analysis & Design: Principles, Skeletal and Cardiovascular implant Design; Selection of material, Stress and Functional Analysis, Failure Criteria, Fatigue Analysis, and Optimal Design; case studies, Computer aided design methods, design of subsystems.

Tools: Computational methods and tools in Design and Analysis, 3-D Modeling and Simulation, Systematic approach for Creation of Virtual 3-D models (digital prototypes), Visualization and Physical Simulation, Matrix transformations, Geometric modeling, Design of artificial organs and prostheses.

Product Development: Product development for solving Biomedical, Biotechnological, and Ergonomic problems. Teamwork in design, Establishing Customer Needs, Writing Specifications, Legal and Financial Issues.

BS-501 Research Methodology 3 C.hr.

Introduction: Problem identification, Problem Statement, Objectives, Literature Review & Referencing, Conceptual Framework/Hypotheses, Planning, Methods and Procedures, Presenting Professional Papers.

Data Collection & Analysis: Introduction to data collection and analysis, Statistical measures, hypothesis testing, linear regression and analysis of variance in application-oriented manner. Data collection methods using various instruments, Analysis of experimental and quasi-experimental methods. Presentation of research findings.

Detail of Course
Elective Courses

BM-521 Clinical Instrumentation 3 C.hr.

Analysis and design of transducers and signal processors; measurements of physical, chemical, biological, and physiological variables; special purpose medical instruments, systems design, storage and display, grounding, noise, and electrical safety. Development of devices used in a clinical or biological environment.

BM-522 Design of Medical Devices 3 C.hr.

Design of medical device, Problem identification, specifications, preliminary design, review, iteration, testing, marketing and economic considerations for manufacturing, Regulation, Controls and Clinical trials. Medical device system safety analysis and human factors. Medical product liability and malpractice.

BM-523 Embedded Systems & Applications 3 C.hr.

Fundamentals of real time and embedded systems. Real time operating systems. Design methodologies. Development, debugging tools and programming languages. Reliability. Case studies and applications.

Recommended Books:

- Barry. B.Brey, Embedded Controller: 80186, 80288 and 80386 Ex 1st Ed.

BM-524 Medical Microsystems 3 C.hr.

Fundamental and advanced fabrication process for integrating materials into microstructures and microdevices. Micropatterning, moulding, sensing, and actuation technologies. Research concepts and applications of Microsystems at the molecular and cellular level. Applications such as

DNA micro-arrays, drug and gene delivery, micro-sensors, actuators for research, microstructures for implants and micro-devices for prostheses.

BM-525 Biomaterial Science & Engineering 3 C.hr.

Basic understanding of materials' Properties, Biocompatibility, Performance requirements of materials for implants. Structure-property relationships, in vivo and vitro performances of polymers, metals, ceramics, glasses, etc, used for manufacturing implants and devices. Practical experience in design, fabrication, and testing of biomaterials and devices; mechanical testing, tissue response, and design to optimize response, interfacing for Biomedical Engineering, Principles of tissue engineering, cell-material interactions, cellular scaffolding and genetic engineering, in vitro and vivo models.

BM-526 Rehabilitation Engineering 3 C. hr.

Overview, Design and Prescription of prosthetic limbs, orthotic, seating & positioning systems. Introduction to injuries, disability, human movement, kinesiology. Biomechanics, Gait analysis, prosthetics, orthotics and mobility assist technology. Improvement of performance and prevention of injuries.

BM-527 Cell & Molecular Biology 3 C.hr.

Structure-function relationships at the molecular and cellular levels. Emphasis on basic genetic mechanisms; control of gene expression; membrane structure, transport and traffic; cell signaling; cell adhesion; mechanics of cell division; and cytoskeleton.

BM-528 Advanced Biomedical Signals & Systems 3 C.hr.

Introductions to the origins of biomedical signals; challenges in acquisition and interpretation; time and frequency domain representation; Filter Design and applications; Random signals and stochastic processes; parametric and nonparametric estimation of power spectral density; case studies: instrumentation, signal acquisition, analysis and interpretation in a hospital sleep diagnostic laboratory. Time-frequency and time-scale analysis of biomedical signals; case studies: signals in a hospital ICU/operating theater. Adaptive processing of biomedical signals and applications. Emerging techniques in medical signal processing. Application case studies: EEG/EMG and evoked potentials.

BM-529 Medical Informatics 3 C.hr.

History of Patient Record, Introduction to Computer Based Patient Record (CPR), Data from Patients, Coding and Classification, Strategies for Data Entry, Representation of Time and Clinical Use of the CPR, Clinical Departmental and Support Systems. Scope of Hospital Information

System (HIS), Challenges for the Health Care Sector, State of Transition, Objectives and Requirements, Planning, Modeling, Development, Architecture and Clinical Uses of HIS. Decision Support Models, Medical Reasoning, Quantitative & Qualitative Methods, Performance & steps involved, Uncertainty in Medical Judgment, Probability Theory and Decision Analysis. Characteristics & Implementing of Decision Support Systems.

BM-530 Telemedicine System 3 C.hr.

Introduction & Benefits of telemedicine. Communication infrastructure-LAN and WAN technology. Satellite, Mobile, Internet technology for telemedicine. Video and audio conferencing. Medical information storage and management for telemedicine, patient information, medical history, test reports, medical images, diagnosis and treatment. Hospital information systems, Doctors, paramedics, facilities. Pharmaceutical, Security and Confidentially of medical records and access control. · Cyber laws, Access to health Care Services, Health Education and Self Care. Bio-modeling, medical data coding and compression, Functions of DICOM, PACS and HIS for Telemedicine.

BM-621 Advanced Bio-Fluid Mechanics 3 C.hr.

Hemodynamic Theories of Atherogenesis, Womersley models, Steady and unsteady Flows in Curvature, Bifurcation and Branching Arterial Segments, Flow Dynamics, Past Prosthetic Implants. Experimental and Computational Models, Particulate and Mass Transport Simulations in Human Circulation.

BM-622 Tissue & Cell Engineering 3 C.hr.

Tissue Engineering approach for Augmentation or Replacement of Compromised Tissue, Function in Nerve, Micro-vessels, Skin and Cartilage. Integrative exploration, Use of Three-Dimensional Polymeric Scaffolds and Drug Delivery Vehicles. Gene Therapy and Cellular Engineering for Functional repair of Damaged Tissues.

Books Recommended:

- Joseph, D. Bronzino, Tissue Engineering and Artificial Organs, 3rd Ed. 2006.

BM-623 Medical Image Processing 3 C.hr.

Advanced image processing algorithms applied to analysis of medical images; image segmentation (level sets, watershed, active contours) and image registration (mutual information, Thirion Demons, B Spline algorithms); development and application of these algorithms using ITK Toolkit. Medical Image Enhancement, automatic Understanding & Diagnostic Systems.

BM-624 Advanced Medical Imaging 3 C.hr.

Algorithms for Processing and Analyzing Large Volumetric Data-Sets; Process of CT, MRI, Ultrasound; SPECT, etc. 3-D convolution and filtering, geometric transformations, shape features, surface segmentation, regional segmentation, surface tiling, surface reconstruction, volumetric registration. 3-D Rendering, Image Integration & Tagging.

BM 625 Pattern Recognition 3 C.hr.

Theoretical foundations of classification and pattern recognition. Applications in Object, Speech, Texture Recognition, Biomedical Patterns. Image sensing and measuring objects, features and patterns. Data acquisition, preprocessing, invariants, and representation issues. Feature Reduction, Classification. Classifier complexity, bias variance, local and global error, error estimations, rejects, ROC. Bayesian approaches, Discriminant Functions for Normal Class Distributions, Parameter Estimation, Non-parametric Techniques (nearest neighbor rules, Parzen kernel rules, tree classifiers), Linear Discriminant Functions. Supervised learning (Perceptron, LMS algorithms, support vector machines, Back propagation), unsupervised learning and clustering, Neural networks, Combining Classifiers. Support Vector Machines, Hidden Markov Models. Applications of Pattern Recognition to Gene patterns and Biomedical problems.

BM-626 Biomaterials and Drug Delivery 3 C.hr.

Principles of design and engineering of well-defined molecular structures and architectures intended for application in controlled released and organ-tagged drug delivery. Therapeutic basics of Drug Delivery based on Drug Pharma-dynamics and clinical pharma-cokinetics. Biomaterials with specialized structural and interfacial properties to achieve drug targeting and perquisites.

BM-631 Mathematical and Computer Modeling of Physiological Systems 3 C.hr.

Mathematical and computer modeling of physiological systems, Principal emphasis on cardiovascular system and individual nerve cells; other topics include respiratory system and skeletal-muscle system; extensive use of “hands-on” computer.

Note: New Elective courses may be introduced according to latest developments and available resources.

BM-699 Master Thesis 6 C.hr.

Student has to take a topic for literature review and research under the supervision of his advisor. HE/She has to submit the results of his findings in the form of a thesis/report and defend his findings in front of a panel of experts.

RECOMMENDATIONS

Curriculum

It is recommended that for **4 year/8 Semester BS/BE degree and 2 Year MS degree programs in Biomedical Engineering** be introduced so that the proposed curriculum could be adopted by the HEC approved Public and Private Universities. In these universities, core Biomedical Engineering Courses should be uniform. However, the Elective components may vary depending on the level of expertise available in individual academic institution.

It is recommended that the focus of these Elective courses shall be multidisciplinary applications of Biomedical Engineering for the utilization of Health Care Providers. It was emphasized that programs in Biomedical Engineering are the need of the time and universities should be encouraged to launch/strengthen 4 years BS/BE Biomedical Engineering degree program according to international standard.

MS program in Biomedical Engineering should be launched after having bachelor degree in Biomedical Engineering and other relevant degree programs. Further, following recommendations were made:

- HEC sponsored workshop/conference on Biomedical Engineering must be organized.
- Student internship in industry/hospital should be made mandatory for degree requirements.
- Universities offering programs in Biomedical Engineering should have close collaboration with Hospital/Research Centers in health care. The HEC should facilitate this industry/academic partnership/collaboration.
- Research centers/laboratories should be established for Biomedical Engineering at universities/institutes offering programs in this discipline.
- Human Resource Training/Enrichment should be encouraged in the area of Biomedical Engineering.
- Facilities for access to journals/publications/E-books may be provided in this discipline in all the public and private universities.
- Training of Physicians in Biomedical Engineering should be arranged to bridge the gap between End users and Technologists.
- Master training workshops / summer school may be organized to fulfill the shortage of faculty in this area.
- Scholarships for higher education in Biomedical Engineering for graduates in biomedical / electrical / electronic engineering may be reserved.
- Biomedical engineering educator may be biomedical engineer, or traditional engineer with additional degree in life sciences or Medical graduate with degree or certificate in engineering discipline.

ANNEXURE-"A"

Functional English

Objectives: To enhance language skills and develop critical thinking

Course Contents:

Basics of Grammar
Parts of speech and use of articles
Sentence structure, Active and passive voice
Practice in unified sentence
Analysis of phrase, clause and sentence structure
Transitive and intransitive verbs
Punctuation and spelling

Comprehension
Answers to questions on a given text

Discussion
General topics and every day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students)

Listening
To be improved by showing documentaries/films carefully selected by subject teachers)

Translation skills
Urdu to English

Paragraph writing
Topics to be chosen at the discretion of the teacher

Presentation skills
Introduction

Note: ***Extensive reading is required for vocabulary building***

Recommended Books:

1. Functional English

a) Grammar
   1. Practical English Grammar by A. J. Thomson and A. V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492
   2. Practical English Grammar by A. J. Thomson and A. V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506

b) Writing
   1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.

c) Reading/Comprehension
   1. Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.

d) Speaking

Communication Skills

Objectives: To enable the students to meet their real life communication needs

Course Contents

Paragraph writing
Practice in writing a good, unified and coherent paragraph

Essay writing
Introduction

CV and job application

Translation skills
Urdu to English

Study skills
Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension

Academic skills
Letter / memo writing and minutes of the meeting, use of library and internet recourses

Presentation skills
Personality development (emphasis on content, style and pronunciation)

Note: documentaries to be shown for discussion and review

Recommended Books:

Communication Skills

a) Grammar
   1. Practical English Grammar by A. J. Thomson and A. V. Martinet. Exercises 2. Third edition. Oxford University Press 1986. ISBN 0 19 431350 6.

b) Writing
   1. Writing. Intermediate by Marie-Chrisitine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 7 Pages 45-53 (note taking).
   2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).

c) Reading
   1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.
   2. Reading and Study Skills by John Langan
   3. Study Skills by Riachard Yorky.

Technical Writing and Presentation Skills

Objectives: To enhance language skills and develop critical thinking

Course Contents

Presentation skills

Essay writing
Descriptive, narrative, discursive, argumentative

Academic writing
How to write a proposal for research paper/term paper

How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)

Technical Report writing

Progress report writing

Note: Extensive reading is required for vocabulary building

Recommended Books:

Technical Writing and Presentation Skills

a) Essay Writing and Academic Writing
   1. Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 435407 3 (particularly suitable for discursive, descriptive, argumentative and report writing).
   2. College Writing Skills by John Langan. McGraw-Hill Higher Education. 2004.
   3. Patterns of College Writing (4th Edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Press.

b) Presentation Skills

c) Reading
   The Mercury Reader. A Custom Publication. Compiled by northern Illinois University. General Editors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharton. (A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).

Annex "B"

COURSES FOR SOCIAL SCIENCE

Sociology and Development

Objectives: The main objective of this course is to apprise potential engineers about social factors that contribute towards enhancing their professional performance for the good of society and the country. This course is culture specific and has to be taught within the context of local and national socio-economic environment. The engineers are expected to supervise several people in different capacities and their understanding about human behaviour is critical for their optimum performance. Modification of human behaviour or getting work done from sub-ordinates and seniors remain a major challenge for all the professional engineers. This course will enhance understanding about the determinants of human behaviour, which ultimately will result in improved individual efficiency.

Course Contents

1. Introduction to Sociology
- 1.1 What is sociology?
- 1.2 Nature, Scope, and Importance of Sociology
- 1.3 Social Interactions
- 1.4 Social Groups
- 1.5 Social Institutions

2. Culture and Related Concepts
- 2.1 Definition of Culture
- 2.2 Types of Culture
- 2.3 Elements of Culture
- 2.4 Role of Culture in Organization
- 2.5 Socialization and Personality

3. Interpersonal Relations
- 3.1 Interpersonal Behaviour
- 3.2 Formation of Personal Attitudes
- 3.3 Language and Communication
- 3.4 Motivations and Emotions
- 3.5 Public Opinion

4. Social Stratification
- 4.1 Factors of Social Stratification
- 4.2 Caste and class
- 4.3 Power, Prestige, and Authority
- 4.4 Social Mobility
- 4.5 Migration

5. Human Ecology
- 5.1 Ecological Processes
- 5.2 Ecosystem and energy
- 5.3 Ecosystem and Physical Environment
- 5.4 Solid Waste Disposal
- 5.5 Pollution

6. Population Dynamics

6.1 World Population Growth and Distribution
6.2 Population Dynamics in Pakistan
6.3 Causes and Consequences of Urbanization
6.4 Population Policy in Pakistan
6.5 Population and Development

7. Community Development

7.1. Meaning, Scope, and Subject Matter of Community Development
7.2 Processes of Community Development
7.3 Community Development Programmes in Pakistan
7.4 Community Organization and Related Services
7.5 Cooperation and Conflict in Community Development

8. Deviance and Crime

8.1 Crime as a Social and Cultural Phenomenon
8.2 Crime and Social Organization
8.3 Organized Crime
8.4 Culture Based Crime
8.5 Economics of Crime

9. Sociology of Change and Development

9.1 What is Social Change and Development?
9.2 Dynamics of Social Change
9.3 Role of NGOs in Development
9.4 World System and Development
9.5 Gender and Development
9.6 Introduction to linguistics

Recommended Readings:

1. *Allport, G. W. (1985). The Historical Background of Modern Social Psychology. New York, Random House.*
2. *Bernard, A. and T. Burgess (2004). Sociology, Cambridge University Press.*
3. *DuBrin, A. J. (2007). Human Relations: Interpersonal Job Oriented Skills. New York, Prentice Hall.*
4. *Gardezi, H. N., Ed. (1991). Understanding Pakistan: The Colonial Factor in Societal Development. Lahore, Maktaba Fikr-o-Danish.*
5. *Hafeez, S. (1991). Changing Pakistan Society. Karachi, Royal Book Company. Gardezi, H. N., Ed. (1991).*
6. *Jones, G. W. (2005). "Why are Population and Development Issues not Given Priority?" Asia-Pacific Population Journal **20** (1).*
7. *Macionis, J. J. (1999). Sociology 7th Edition, National Book Foundation, Islamabad*
8. *Maser, C. (1997). Sustainable Community Development: Principles and Concepts. Florida St. Lucie Press.*
9. *Nelson, N. and S. Wright (1995). Power and Participatory Development: Theory and Practice. London, Intermediate Technology Publications.*

10. *Syed, S. H. (2003). The State of Migration and Multiculturalism in Pakistan: The Need for Policy and Strategy. Islamabad, UNESCO: 1-30.*
11. *Utton, A. E. (1976). Human Ecology, West View Press.*
12. *Webster, A. (1990). Introduction to Sociology of Development. London, Nacmillan Education Ltd.*
13. *Weiss, A. M. (2001). Power and civil society in Pakistan, Oxford University press.*

Social Anthropology

Objectives: The students are expected to learn anthropological skills for application by professional engineers and other related practitioners. Societal growth needs are to be understood within our own cultural environment. Such a body of applied knowledge will result in improving the professional performance of would-be engineers. As culture and society play an important role towards all human activities, this course will help students relate technical skills to the societal needs and requirements.

Course Contents

I Introduction

1. Anthropology and Social Anthropology
2. Fields of Anthropology
3. Anthropological Research Methods
4. Social Anthropology and other Social Sciences
5. Significance of Social Anthropology

II Culture

1. Definition, Properties and Taxonomy
2. Evolution of Growth and Culture
3. Evolution of Man: Religious and Modern Perspectives
4. Evolution of Culture
5. Culture and Personality

III Evolution and Growth of Culture

1. Evolution of Man
2. Schools of Thought in Cultural Anthropology
3. Acculturation
4. Enculturation
5. Ethnocentrism and Xenocentrism

IV Language and Culture

1. Communication
2. Structural Linguistics
3. Historical Linguistics
4. Relationship between Language and Culture
5. Ethnography

V Economic System

1. Global Economic System
2. The Allocation of Resources
3. The Conversion of Resources
4. The Distribution of Goods and Services
5. Poverty and Inequality

VII Marriage and Family

1. Marriage and Mate Selection
2. The Family: Types and Functions
3. Kinship System
4. Structure and Function of Family
5. Gender Relations

VIII Political Organization

1. Political Sociology
2. Origin of Political Organization and Organizational System
3. Types of Political Organizations
4. Power Politics and Factionalism in Pakistan
5. Resolution of Conflict

IX Religion and Magic

1. The Universality of Religion
2. Comparative Religions
3. Religion and Society
4. Religious Beliefs and Practices
5. Witchcraft and Sorcery

XI Culture Change

1. Forms of Art
2. Expressive Culture
3. Process of Cultural Change
4. Cultural Change in the Modern World
5. Cultural Change in Pakistani society

Recommended Books:

1. *Ahmad, Akbar S. 1990. Pakistani Society, Karachi, Royal Books Co.*
2. *Bernard, H. Russel. 1994. Research Methods in Anthropology, Qualitative and Quantitative Approaches. London: Sage Publications*
3. *Bodley, John H. 1994. Cultural Anthropology, California: Mayfield Publishing Co.*
4. *Brogger, Jan. 1993. Social Anthropology and the Lonely Crowd. New Delhi: Reliance Publishing*
5. *Ember, Carol R. & Ember Melvin. 2005. Anthropology, 11th ed. Englewood Cliffs: Prentice Hall, Ince. Harper and Row*
6. *Harris Marvin. 1987. Cultural Anthropology. New York: Harper and Row*
7. *Harris Marvin. 1985. Culture, People, nature; An Introduction to General Anthropology London: Harper and Row*

8. *Haviland, W. A. (2005). Anthropology: The Human Challenge. New York, Thomson Learning Inc.*
9. *Hertzler J. O. 1981. The Social Structure of Islam. Cambridge: Cambridge University Press.*
10. *Keesing, Roger m. 1998. Cultural Anthropology: A contemporary perspective. 3rd Ed. New York: Harcourt Brace College Publishers.*
11. *Kottak, Conard Phillip. 2002. Anthropology: The Exploration of Human Diversity. 9th Ed. Boston: McGraw Hill Higher Education.*
12. *Kennedy, Charles H. 1992. Pakistan, London: Westview Press,.*
13. *Marron, Stanley. 1057. Pakistani Society and Culture. New Heaven*
14. *Wilson, Richard A. 1996. Human Rights, Culture and Context: Anthropological Perspective. London: Pluto Press.*

Understanding Psychology and Human Behaviour

Course Contents:

- What is Psychology?
- Nature, Scope and Application with Special Reference to Pakistan
- Different Schools of Psychology
- Methods of Psychology
- Learning
- Intelligence and Artificial Intelligence
- Personality and its Assessment
- Understanding Maladjustive Behaviour
- Positive Emotional States and Processes
- Stress Management and Anger Management

Recommended Books:

1. Atkinson R. C., & Smith E. E. (2000), Introduction to Psychology (13th Ed.), Harcourt Brace College Publishers.
2. Fernald, L. D., & Fernald, P. S. (2005), Introduction to Psychology, USA: WMC Brown Publishers.
3. Hergenhahn, B. R. (2001). An Introduction to the History of Psychology, New York: Wadsworth.
4. Goodwin, C. J, (2000) Research in Psychology: Methods and Design, (3rd ed.), New York: John Wiley & Sons.
5. Synder, C. R., & Lopez, S. J. (2007) Positive Psychology, USA, Sage Publications.
6. Allen, B. P. (1997), Personality Theories: Development, Growth and Diversity, (2nd Ed.), Boston: Allyn & Bacon.
7. Cohen, R. J., & Swerdlik, M. E. (2005) Psychological Testing & Assessment (6th ed.), New York: McGraw-Hill.
8. Corcini, R., (2000). Current Psychotherapies. London: Thompson & Co Publishers.
9. Comer, R. J. (2004). Abnormal Psychology, USA: Freeman & Company.
10. Schwartz, B., Wassernman, E., & Robbins, S. (2002), Psychology of Learning and Behaviour, 5th Ed. Norton and Company.

Professional Psychology

Course Contents:

- Introduction to Professional Psychology
- Psychological Testing
- Educational Psychology
- Industrial/Organizational Psychology
- Social Psychology
- Health Psychology
- Clinical Psychology
- Positive Psychology
- Legal, Ethical, and Professional Issues.

Recommended Books:

1. Crow, L., & Crow, A. (2000) Educational Psychology, New Delhi: Eurosia Publishing House Ltd.
2. Spiegel, P. K., & Koocher, G. P. (1998), Ethics in Psychology, New York: Oxford University Press
3. Snyder, C. R., & Lopes, S. J. (2000), Handbook of Positive Psychology, New York: Oxford University Press.
4. Compton, W. C. (2005), Introduction to Positive Psychology, USA, Thomson Wadsworth.
5. Debra, L. N. & James Compbell Quick, (2000) Organizational Behaviour (3rd Ed), Cincinnat: South Western.
6. Fred Luthans, Alexander, D. S. & Edwin, A. Locke (2000) (Eds), Handbook of Principles of Organizational Behaviour, London: Blackwell.
7. Brannon, L. & Reist, J. (2000), Health Psychology: An Introduction to Behaviour and Health (4th Ed.), USA Wadsworth.
8. Donohue, W. & Ferguson, K. (Eds), (2003), Handbook of Professional Ethics for Psychologists; Issues, Questions and Controversies, London: Sage Publications.
9. Meyers, D. (2005), Social Psychology, 8th Ed. McGraw Hill Inc.
10. Cooper, J. & Hogg, M. (2003) Handbook of Social Psychology, Sage Publications
11. Halgin, R. P., Whitbourne, S. K., & Halgin, R. (2004), Abnormal Psychology: Clinical Perspectives on Psychological Disorders, New York: McGraw-Hill.
12. Thorndike R. L., & Hage, E. P. (1995), Measurement and Evaluation in Psychology and Education (4th Ed), New York, MacMillan.

Organizational Behaviour

Course Contents

- Introduction to Organizational Behaviour
  - Organizational Disciplines and topics
  - Psychological Perspective
  - Social-Psychological Perspectives
- Structure and Control in Organization
  - Introduction
  - Bureaucracy

- Managerial Work
- Contingency theory
- Organizational Design

- Individual and Work Learning
  - Learning Theories
  - Learning and Work

- Stress
  - Types of Stress and Work
  - Occupational Stress Management

- Individual Differences
  - Personality and its factors
  - Personality dimensions and social learning
  - Intelligence

- Motivation and Job Satisfaction
  - Needs at Work
  - Theories of Motivation and job satisfaction
  - Correlates of Job satisfaction
  - Correlates of Job satisfaction

- Group and Work
  - Social Interaction
  - Dramaturgy and impression Management
  - Social Skill

- Group and Inter group Behaviour
  - Group Structure & Norms
  - Group Processes
  - How throne Studies

- Leadership
  - Leadership as an attribute
  - Leadership Style

- Patterns of Work
  - Work-the classical approach
  - Marx, Weber, & The critique of labor
  - Foucault & Disciplinary Power

- Conflict and Consent in Work
  - The labor Process debate
  - Work place control and resistance
  - Industrial conflict and industrial relations

- Organizational culture
  - Organizational culture and strategic management
  - Exploring organizational culture

- Evaluating concept of culture

Recommended Books:

1. Finchan, R., & Rhodes, P. (2003), Principles of Organizational Behaviour, 3rd Ed. Oxford.
2. Noe, R., Hollenbeck, J. Gerhart, B., & Wright, P. (2006), Human Resource Management, 5th Ed., McGraw-Hill.
3. Newstrom John W. (2007), Organizational Behaviour, (12th Ed), McGraw-Hill.
4. Luthan Fred, (2005), Organizational Behaviour, McGraw-Hill Inc.
5. Robins, Stephen, (2005), Organizational Behaviour, McGraw Hill Inc.

INTRODUCTION TO SOCIOLOGY

Course Contents:

- The Nature of Sociology
  - The study of social life
  - Exploring the global village
  - Sociology as a science
  - The Sociological imagination
  - The development of Sociology
  - Pioneers of Sociology
  - Nature, scope and subject matter of Sociology
  - Brief historical development of Sociology
  - Society and community
  - Relationship with other social sciences
  - Social Interaction Processes

- Social groups
  - Definition and functions
  - Types of social groups

- Social institutions
  - Definition
  - Structure and function of social institutions
  - Inter-relationships among various social institutions

- Culture and related concepts
  - Definition and aspects of culture
  - Elements of culture
  - Organization of culture
  - Other concepts, cultural relativism, sub-cultures, ethnocentrism, culture lag

- Socialization and personality
  - Role and status
  - Socialization
  - Culture and personality

- Deviance and social control
  - Definition and types of deviance
  - Juvenile delinquency
  - Formal and information methods of social control
- Social stratification
  - Approach to study social stratification
  - Caste class and race as basics of social stratification
- Major perspectives in Sociology
  - Functionalist perspective
  - Conflict perspective
  - Interactionstic perspective
- Social Control and deviance
  - Agencies of social control
- Social stratification
  - Determinants of social stratification
  - Social mobility, types and definition
  - Dynamics of social mobility
- Concept of social movement
  - Theories of social movement
  - Social and cultural change
- Social and cultural change
  - Definition of social change
  - Dynamics of social change
  - Impact of globalization on society and culture
  - Resistance to change
- Collective behaviour
  - Definition
  - Characteristics
  - Causes
  - Types
  - Social movements
  - Mob and crowd behaviour

Recommended Books:

1. Neulreck, Kenneth, J. 2005, Sociology: Diversity, Conflict and Change, Boston.
2. Barnard, Andy. 2004. Sociology, Cambridge University Press
3. Giddens, Anthony, 2004, Sociology 4th Edition, Cambridge Polity Press.
4. Albrow, Martin, 2003, Sociology, London Routledge.
5. Richard, T. Schaefer, 2003, Sociology5th Edition, McGraw-Hill College
6. Kendall, Diana, 2004. Sociology in our Times, 4th Ed, Wadsworth
7. Tyler Melissa, Wallace Claire & Abbott Pamela, 2005, An Introduction to Sociology, 3rd Ed. Routledge.

Critical Thinking

Course Contents:

- The Power of Critical Thinking
  - Claims and Reasons
  - Reasons and Arguments
  - Arguments in the Rough

- The Environment of Critical Thinking
  - Perils of Haunted Mind
  - Self and the Power of the Group
  - Subjective and Social Relativism
  - Skepticism

- Making Sense of Arguments
  - Arguments Basics
  - Patterns
  - Diagramming Arguments
  - Assessing Long Arguments

- Reasons for Belief and Doubt
  - Conflict Experts and Evidence
  - Personal Experience
  - Fooling Ourselves
  - Claims in the News

- Faulty Reasoning
  - Irrelevant Premises
  - Genetic Fallacy, Composition, Division
  - Appeal to the Person, Equivocation, Appeal to Popularity
  - Appeal to Tradition, Appeal to Ignorance, Appeal to Emotion
  - Red Herring, Straw Man

- Unacceptable Premises
  - Begging the Question, False Dilemma
  - Slippery Slope, Hasty Generalization
  - Faulty Analogy

- Deductive Reasoning: Propositional Logic
  - Connectives and Truth Values
  - Conjunction, Disjunction, Negation
  - Conditional, Checking for Validity
  - Simple Arguments, Tricky Arguments
  - Streamlined Evaluation

- Deductive Reasoning: Categorical Logic
  - Statements and Classes
  - Translations and Standard Form
  - Terms, Quantifiers
  - Diagramming Categorical Statements

- Sizing up Categorical Syllogisms

- Inductive Reasons
  - Enumerative Induction
  - Sample Size, Representativeness, Opinion Polls
  - Analogical Induction
  - Casual Arguments, Testing for Causes
  - Casual Confusions

- Inference to the Best Explanation
  - Explanations and Inference
  - Theories and Consistency
  - Theories and Criteria
  - Testability, Fruitfulness, Scope, Simplicity
  - Conservatism

- Judging Scientific Theories
  - Science and Not Science
  - The Scientific method, Testing Scientific Theories
  - Judging Scientific Theories
  - Copernicus versus Ptolemy, Evolution Versus Creationism
  - Science and Weird Theories
  - Making Weird Mistakes
  - Leaping to the Weirdest Theory, Mixing What Seems with What is
  - Misunderstanding the Possibilities
  - Judging Weird Theories
  - Crop Circles, Talking with the Dead

RECOMMENDED BOOKS:

1. Vaughn Lewis, 2005, The Power of Critical Thinking, Oxford University Press.
2. Paulsen David W., Cederblom Jerry:2000, Critical Reasoning, Wadsworth
3. Restall Greg. 2005, Logic: An Introduction, Routledge

Introduction to Philosophy

Course Contents:

- Definition and Nature of Philosophy
- Theory of Knowledge
  - Opinion and Knowledge
  - Plato, the Republic Selection
  - Knowledge through Reason
  - Descartes Meditation on First Philosophy
  - Knowledge through Experience
  - Hume an Inquiry concerning Human Understanding (Selection)
  - Experience Structured by the Mind

- Kant Critique of Pure Reason (Selection
- Knowing and Doing
- James Pragmatism (Selection)
- Knowledge and Emotion
- Jaggar Love and Knowledge (Selection)

- Philosophy of Religion
  - Proving that Existence of God
  - Anselm, Aquinas, Paley, Dawkins (Selection)
  - Justifying Religious Beliefs
  - Pascal Pensees (Selection)
  - James The will to Believe Selection
  - Freud the Future of An Illusion (Selection)
  - Confronting the Problems of Evil
  - Mackie Evil and Omnipotence (Complete)
  - Hick Philosophy of Religion (Selection)

- Metaphysics
  - Idealism and Materialism
  - Berkeley Three Dialogues Between Hylas and Pholonous (Selection)
  - Armstrong Naturalism, Materialism and First Philosophy (Selection)
  - The Mid-Body Problem
  - Descartes Meditations on First Philosophy (Selection)
  - O'Hear Introduction to the Philosophy of Science (Selection)
  - Dennett The Origins of Selves (Complete)
  - Pali Canon (Selection)
  - Penelhum Religion and Rationality (Selection)

- Freedom to Choose
  - Libertarianism
  - James The Dilemma of Determinism (Selection)
  - Taylor Metaphysics (Selection)
  - Determinism
  - Hospers Meaning and Free Will (Selection)
  - Skinner Walden Two (Selection)
  - Compatibilism
  - Stace Religion and the Modern Mind (Selection)
  - Radhakrishnan Indian Philosophy (Selection)

- Ethics
  - Fulfilling Human Nature
  - Aristotle Nicomachean Ethics (selection)
  - Loving God
  - Augustine The Morals of the Catholic Church and the City of God (Selection)
  - Following Natural Law
  - Aquinas Summa Theologiae (Selection)
  - Doing One's Duty

- Kant Fundamental Principles of the Metaphysics of Morals (Selection)
- Maximizing Utility
- Mill Utilitarianism (Selection)
- Turning Values of Upside Down
- Nietzsche Human, All too Human and Beyond Good and Evil (Selection)
- Creating Ourselves
- Sartre Existentialism is a Humanism (Selection)
- Hearing the Feminine Voice
- Gilligan In a Different Voice (Selection)
- Baier What do Women Want in a Moral Theory (Selection)

- Political and Social Philosophy
  - The State as Natural
  - Plato the Republic (Selection)
  - Aristotle Politics (Selection)
  - The State as a Social Contract
  - Hobbes Philosophical Rudiments Concerning Government and Society (Selection)
  - Locke the Second Treatise of Government (Selection)
  - Liberty of the Individual
  - Mill On Liberty (Selection)
  - Alienation in Capitalism
  - Marx Economic and Philosophic Manuscripts of 1844 (Selection)
  - Justice and Social Trust
  - Rawls A Theory of Justice (Selection)
  - Nozick Anarchy, State, and Utopia (Selection)
  - Held Rights and Goods (Selection)
  - Women in Society
  - Wollstonecraft A Vindication of the Rights of Women (Selection)
  - De Behaviour The Second Sex (Selection)
  - The Value of Philosophy
  - Russel The Problems of Philosophy (Selection)
  - Midgley Philosophical Plumbing (Selection)

RECOMMENDED BOOKS:

1. Abel Donald C., Stumpf Samuel Enoch, 2002. Elements of Philosophy: An Introduction, 4th Ed. McGraw Hill.
2. Scruton Roger, 2001. A short History of Modern Philosophy, 2nd Ed. Routledge.

MANAGEMENT COURSES

Entrepreneurship

Objective:

Entrepreneurship is an important component in the process of economic development. The purpose of this course is to analyse the theories of entrepreneurship and to go for case studies of successful entrepreneurs.

Course Contents:

Introduction: The concept of entrepreneurship, the economist view of entrepreneurship, the sociologist view, Behavioural approach, Entrepreneurship and Management.

The Practice of Entrepreneurship: The process of entrepreneurship, Entrepreneurial Management, the entrepreneurial business, Entrepreneurship in service institutions, the new venture.

Entrepreneurship and Innovation: The innovation concepts, Importance of innovation for entrepreneurship, Sources of innovative opportunities, The innovation process, Risks involved in innovation.

Developing Entrepreneur: Entrepreneurial profile, Trait approach to understanding entrepreneurship, Factors influencing entrepreneurship, The environment, Socio cultural factors, Support systems.

Entrepreneurship Organization: Team work, Networking organization, Motivation and compensation, Value system.

Entrepreneurship and SMES: Defining SMEs, Scope of SMEs, Entrepreneurial, managers of SME, Financial and marketing problems of SMEs.

Entrepreneurial Marketing: Framework for developing entrepreneurial marketing, Devising entrepreneurial marketing plan, Entrepreneurial marketing strategies, Product quality and design.

Entrepreneurship and Economic Development: Role of entrepreneur in the economic development generation of services, Employment creation and training, Ideas, knowledge and skill development, The Japanese experience.

Case Studies of Successful Entrepreneurs

Text-Books:

- Paul Burns and Jim Dew Hurst: Small Business and Entrepreneurship.
- P. N. Singh: Entrepreneurship for Economic Growth.
- Peter F. Drucker: Innovation and Entrepreneurship Peter F. Drucker.
- John B. Miner: Entrepreneurial Success.

Principles of Management

Objectives:

This is a rudimentary course for the students of business administration. The focus of attention will be given to learning fundamental principles of management and of managing people and organization in a historical as

well as contemporary world. Students are expected to develop analytical and conceptual framework of how people are managed in small, medium and large public and private national and international organizations.

Course Contents:

- Introduction, overview and scope of discipline
- The evolution and emergence of management thought
- Management functions
- Planning concepts, objectives, strategies and policies
- Decision making
- Organizing; departmentalization, line/staff authority, commitments and group decision making
- Staffing: principles of selection, performance, career planning
- Leading: Motivation, leadership, communication
- Controlling: the system and process and techniques of controlling
- Management and Society: future perspective

Text Books:

- Stephen P. Robins, Mary Coulter: Management
- H. Koontz Odonnel and H. Weihrich: Management
- Mc Farland: Management: Foundation and Practice
- Robert M. Fulmer: The New Management

Annex "C"

Pakistan Studies (Compulsory)

(As Compulsory Subject for Degree Students)

Introduction/Objectives

Objectives

- To develop vision of Historical Perspective, Government, Politics, Contemporary Pakistan, ideological background of Pakistan.
- To study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

Course Outline

1. **Historical Perspective**
   a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-e-Azam Muhammad Ali Jinnah.
   b. Factors leading to Muslim separatism
   c. People and Land
      i. Indus Civilization
      ii. Muslim advent
      iii. Location and Geo-Physical features.
2. **Government and Politics in Pakistan**
   Political and constitutional phases:
   a. 1947-58
   b. 1958-71
   c. 1971-77
   d. 1977-88
   e. 1988-99
   f. 1999 onward
3. **Contemporary Pakistan**
   a. Economic institutions and issues
   b. Society and social structure
   c. Ethnicity
   d. Foreign policy of Pakistan and challenges
   e. Futuristic outlook of Pakistan

Recommended Books:

1. Burki, Shahid Javed. *State & Society in Pakistan,* The Macmillan Press Ltd 1980.
2. Akbar, S. Zaidi. *Issue in Pakistan's Economy.* Karachi: Oxford University Press, 2000.
3. S.M. Burke and Lawrence Ziring. Pakistan's Foreign policy: An Historical analysis. Karachi: Oxford University Press, 1993.
4. Mehmood, Safdar. *Pakistan Political Roots & Development.* Lahore, 1994.
5. Wilcox, Wayne. *The Emergence of Bangladesh.,* Washington: American Enterprise, Institute of Public Policy Research, 1972.

6. Mehmood, Safdar. *Pakistan Kayyun Toota,* Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
7. Amin, Tahir. *Ethno - National Movement in Pakistan,* Islamabad: Institute of Policy Studies, Islamabad.
8. Ziring, Lawrence. *Enigma of Political Development.* Kent England: WmDawson & sons Ltd, 1980.
9. Zahid, Ansar. *History & Culture of Sindh.* Karachi: Royal Book Company, 1980.
10. Afzal, M. Rafique. *Political Parties in Pakistan,* Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.
11. Sayeed, Khalid Bin. *The Political System of Pakistan.* Boston: Houghton Mifflin, 1967.
12. Aziz, K. K. *Party, Politics in Pakistan,* Islamabad: National Commission on Historical and Cultural Research, 1976.
13. Muhammad Waseem, Pakistan Under Martial Law, Lahore: Vanguard, 1987.
14. Haq, Noor ul. *Making of Pakistan: The Military Perspective.* Islamabad: National Commission on Historical and Cultural Research, 1993.

Annex- 'D'

ISLAMIC STUDIES
(Compulsory)

Objectives:

This course is aimed at:

1 To provide Basic information about Islamic Studies
2 To enhance understanding of the students regarding Islamic Civilization
3 To improve Students skill to perform prayers and other worships
4 To enhance the skill of the students for understanding of issues related to faith and religious life**.**

DETAIL OF COURSES

INTRODUCTION TO QURANIC STUDIES

1) Basic Concepts of Quran
2) History of Quran
3) Uloom-ul-Quran

STUDY OF SELLECTED TEXT OF HOLLY QURAN

1) Verses of Surah Al-Baqra Related to Faith (Verse No-284-286)
2) Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
3) Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
4) Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
5) Verses of Surah Al-Inam Related to Ihkam (Verse No-152-154)

STUDY OF SELLECTED TEXT OF HOLLY QURAN

1) Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No. 6,21,40,56,57,58.)
2) Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
3) Verses of Surah Al-Saf Related to Tafakar, Tadabar (Verse No-1,14)

SEERAT OF HOLY PROPHET (S.A.W) I

1) Life of Muhammad Bin Abdullah (Before Prophet Hood)
2) Life of Holy Prophet (S.A.W) in Makkah
3) Important Lessons Derived from the life of Holy Prophet in Makkah

SEERAT OF HOLY PROPHET (S.A.W) II

1) Life of Holy Prophet (S.A.W) in Madina
2) Important Events of Life Holy Prophet in Madina
3) Important Lessons Derived from the life of Holy Prophet in Madina

INTRODUCTION TO SUNNAH

1) Basic Concepts of Hadith
2) History of Hadith
3) Kinds of Hadith
4) Uloom –ul-Hadith
5) Sunnah & Hadith
6) Legal Position of Sunnah

SELLECTED STUDY FROM TEXT OF HADITH

INTRODUCTION TO ISLAMIC LAW & JURISPRUDENCE

1) Basic Concepts of Islamic Law & Jurisprudence
2) History & Importance of Islamic Law & Jurisprudence
3) Sources of Islamic Law & Jurisprudence
4) Nature of Differences in Islamic Law
5) Islam and Sectarianism

ISLAMIC CULTURE & CIVILIZATION

1) Basic Concepts of Islamic Culture & Civilization
2) Historical Development of Islamic Culture & Civilization
3) Characteristics of Islamic Culture & Civilization
4) Islamic Culture & Civilization and Contemporary Issues

ISLAM & SCIENCE

1) Basic Concepts of Islam & Science
2) Contributions of Muslims in the Development of Science
3) Quran & Science

ISLAMIC ECONOMIC SYSTEM

1) Basic Concepts of Islamic Economic System
2) Means of Distribution of wealth in Islamic Economics
3) Islamic Concept of Riba
4) Islamic Ways of Trade & Commerce

POLITICAL SYSTEM OF ISLAM

1) Basic Concepts of Islamic Political System
2) Islamic Concept of Sovereignty
3) Basic Institutions of Govt. in Islam

ISLAMIC HISTORY

1) Period of Khlaft-e-Rashida
2) Period of Ummayyads
3) Period of Abbasids

SOCIAL SYSTEM OF ISLAM

1) Basic concepts of Social System of Islam
2) Elements of Family
3) Ethical values of Islam

REFERENCE BOOKS:

1) Hameed ullah Muhammad, "**Emergence of Islam**" , IRI, Islamabad
2) Hameed ullah Muhammad, "**Muslim Conduct of State**"
3) Hameed ullah Muhammad, '**Introduction to Islam**
4) Mulana Muhammad Yousaf Islahi,"
5) Hussain Hamid Hassan, **"An Introduction to the Study of Islamic Law"** leaf Publication, Islamabad, Pakistan.
6) Ahmad Hasan, **"Principles of Islamic Jurisprudence"** Islamic Research Institute, International Islamic University, Islamabad (1993)
7) Mir Waliullah, **"Muslim Jrisprudence and the Quranic Law of Crimes" I**slamic Book Service (1982)
8) H.S. Bhatia, **"Studies in Islamic Law, Religion and Society"** Deep & Deep Publications New Delhi (1989)
9) Dr. Muhammad Zia-ul-Haq, **"Introduction to Al Sharia Al Islamia"** Allama Iqbal Open University, Islamabad (2001).