Syllabus

for

Bachelor of Technology *(B-Tech.)* **Programme**

in

Biomedical Engineering

School of Technology,

North-Eastern Hill University, Mawkynroh,

Umshing, Shillong – 793 022

CONTENTS

1. ACRONYMS USED IN SUBJECT CODING

1.1 SUBJECT NOMENCLATURE AND CODING

BM – Biomedical Engineering

MA – Mathematics

PH – Physics

CH – Chemistry

HU – Humanities

ES – Environmental Science

EE – Electrical Engineering

CE – Civil Engineering

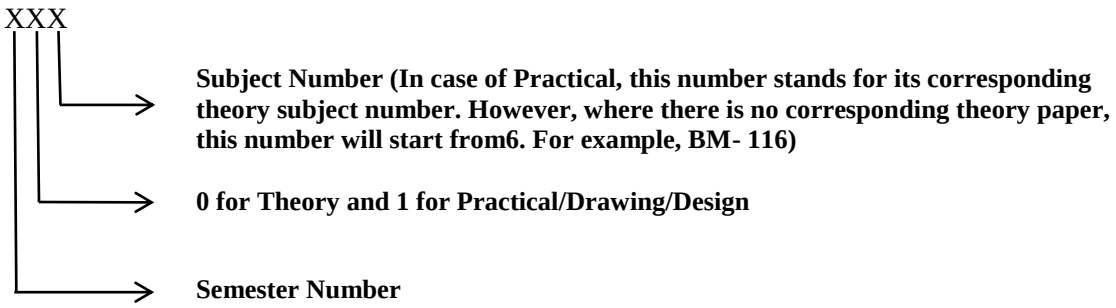
ME – Mechanical Engineering

EC – Electronics and Communication Engineering

IT – Information Technology

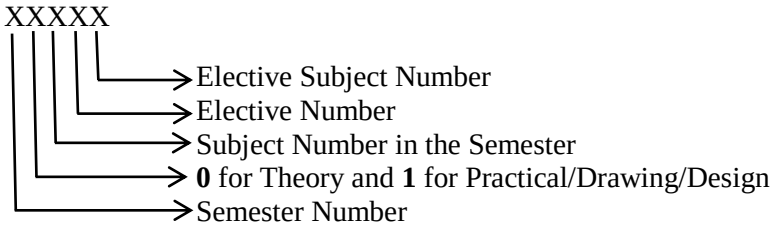
Subject Coding for *Core Paper*:

Three Digit Numeric Numbers Used in Subject Code (e.g.BM –XXX):



Subject Coding for *Elective Paper*:

Five Digit Numeric Numbers Used in Subject Code (e.g. BM –XXXXX)



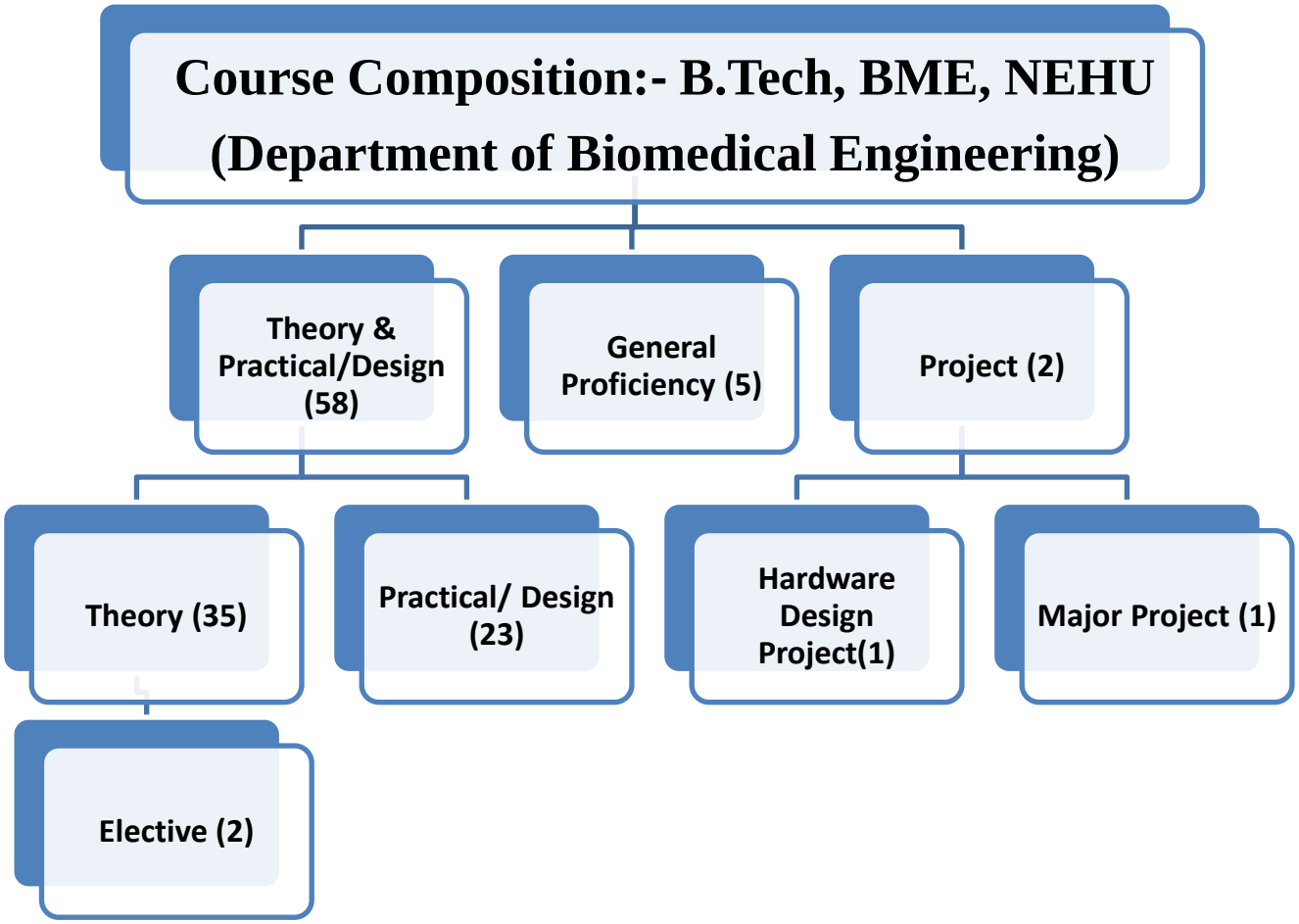
For example, BM – 70412: It is a Seventh (7) Semester First (1) Elective Theory (0) Paper. Paper serial number in the Seventh Semester Paper List is four (4) while elective serial number two (2) in the First Elective Paper List of the Semester.

1.2 GENERAL PROFICIENCY:

Under this paper, the students shall be evaluated through seminars/viva in internal evaluation method. The topics have to be selected by the students/department from the papers taught in the particular semester/year as per the case.

However, GP – III would be based on the industrial training the students shall have to undergo during Vacation/Break after Second Year of B-Tech. curriculum while GP – V would be evaluated through the Grand Viva.

1.3 COURSE COMPOSITION AT A GLANCE



2. SCHEME OF SYLLABI

2.1 SCHEME OF FIRST SEMESTER

BRANCH: Common to all branches **YEAR: I** **GROUP A** **SEMESTER I**

Sl. No	Subject Code	Subject Name	Periods (contact hour(s))			Evaluation Scheme (distribution of marks)					Credits
(THEORY)			**L**	**T**	**P**	**Internal Works**			**ESE**	**SUBTOTAL**	
						TA	**CT**	**TOT**			
1	ES – 101	Elements of Environmental Science	2	1	-	20	20	40	60	100	**3**
2	MA –102	Engineering Mathematics – I	3	1	-	30	30	60	90	150	**4**
3	CH –103	Engineering Chemistry	3	1	-	30	30	60	90	150	**4**
4	IT – 104	Computer Systems and Programming	3	1	-	30	30	60	90	150	**4**
5	EC – 105	Basic Electronics	3	1	-	30	30	60	90	150	**4**
(**PRACTICAL / DRAWING / DESIGN**)											
6	CH –113	Engineering Chemistry Laboratory	-	-	3	20	-	20	30	50	**2**
7	IT – 114	Computer Programming	-	-	3	20	-	20	30	50	**2**
8	EC – 115	Basic Electronics Laboratory	-		3	20	-	20	30	50	**2**
9	CE – 116	Engineering Graphics	-	-	3	20	-	20	30	50	**2**
		Total	**14**	**5**	**12**					**900**	**27**

Total Contact Hours: 31

L– Lecture **T –** Tutorial **P**– Practical **TA –** Teachers Assessment **Total Marks: 900**

CT– Class Test **TOT –** Total Internal Marks **ESE–** End Semester Examination **Total Credits: 27**

2.2 SCHEME OF SECOND- SEMESTER

BRANCH: Common to all branches **YEAR: I** **GROUP B** **SEMESTER II**

Sl. No	Subject Code	Subject Name	Periods(contact hour(s))			Evaluation Scheme (distribution of marks)					Credits
(**THEORY**)			**L**	**T**	**P**	**Internal Works**			**ESE**	**SUB TOTAL**	
						TA	CT	TOT			
1	HU – 201	Professional Communication Skills	2	1	-	20	20	40	60	100	3
2	MA – 202	Engineering Mathematics - II	3	1	-	30	30	60	90	150	4
3	PH – 203	Engineering Physics	3	1	-	30	30	60	90	150	4
4	ME – 204	Engineering Mechanics	3	1	-	30	30	60	90	150	4
5	EE – 205	Basic Electrical Engineering	3	1	-	30	30	60	90	150	4
(**PRACTICAL / DRAWING / DESIGN**)											
6	HU-211	Digital English Language Laboratory	-	-	3	20	-	20	30	50	2
7	PH – 213	Engineering Physics Laboratory	-	-	3	20	-	20	30	50	2
8	EE – 215	Basic Electrical Laboratory	-	-	3	20	-	20	30	50	2
9	ME – 216	Workshop Practice	-	-	3	20	-	20	30	50	2
10	GP – I	General Proficiency – I	-	-	-	-	-	50	-	50	2
			14	**5**	**12**					**950**	**29**

Total Contact Hours: 31

L– Lecture **T –** Tutorial **P**– Practical **TA –** Teachers Assessment **Total Marks: 950**

CT– Class Test **TOT –** Total Internal Marks **ESE–** End Semester Examination **Total Credits: 29**

2.3 SCHEME OF THIRD SEMESTER

BRANCH: Biomedical Engineering **YEAR: II** **SEMESTER III**

Sl. No	Subject Code	Subject Name	Periods (contact hour(s))			Evaluation Scheme (distribution of marks)					Credits
(THEORY)			L	T	P	Internal Works			ESE	SUB TOTAL	
						TA	CT	TOT			
1	MA-301	Engineering Mathematics – III	3	1	-	30	30	60	90	150	**4**
2	BM-302	Biomaterials	3	1	-	30	30	60	90	150	**4**
3	EC-303	Signal and Systems	3	1	-	30	30	60	90	150	**4**
4	BM-304	Human Anatomy & Physiology-I	3	1	-	30	30	60	90	150	**4**
5	IT-305	Data Structures and Algorithms	3	1	-	30	30	60	90	150	**4**
(**PRACTICAL / DRAWING / DESIGN**)											
6	BM-314	Human Anatomy & Physiology Laboratory-I	-	-	3	20	-	20	30	50	**2**
7	BM-315	Data Structure using C Laboratory	-	-	3	20	-	20	30	50	**2**
8	BM-316	Biomedical signals and systems Laboratory	-	-	3	20	-	20	30	50	**2**
		Total	**15**	**5**	**9**					**900**	**26**

Total Contact Hours: 29

L– Lecture **T –** Tutorial **P**– Practical **TA –** Teachers Assessment **Total Marks: 900**

CT– Class Test **TOT –** Total Internal Marks **ESE–** End Semester Examination **Total Credits: 26**

2.4 SCHEME OF FORTH SEMESTER

BRANCH: Biomedical Engineering **YEAR: II** **SEMESTER IV**

Sl. No	Subject Code	Subject Name	Periods(contact hour(s))			Evaluation Scheme (distribution of marks)					Credits
(THEORY)			**L**	**T**	**P**	**Internal Works**			**ESE**	**SUB TOTAL**	
						TA	CT	TOT			
1	MA-401	Statistics and Random Processes	3	1	-	30	30	60	90	150	**4**
2	BM-402	Biomedical Instrumentation –I	3	1	-	30	30	60	90	150	**4**
3	BM-403	Biomechanics	3	1	-	30	30	60	90	150	**4**
4	BM-404	Medical Biochemistry	3	1	-	30	30	60	90	150	**4**
5	BM -405	Human Anatomy & Physiology-II	3	1	-	30	30	60	90	150	**4**
(**PRACTICAL / DRAWING / DESIGN**)											
6	BM-412	Biomedical Instrumentation Laboratory –I	-	-	3	20	-	20	30	50	**2**
7	BM-414	Medical Biochemistry Laboratory	-	-	3	20	-	20	30	50	**2**
8	BM-415	Human Anatomy & Physiology Laboratory-II	-	-	3	20	-	20	30	50	**2**
9	GP-II	General Proficiency – II				-	-	50	-	50	**2**
		Total	**15**	**5**	**9**					**950**	**28**

Total Contact Hours: 29

L– Lecture **T –** Tutorial **P**– Practical **TA –** Teachers Assessment **Total Marks: 950**

CT– Class Test **TOT –** Total Internal Marks **ESE–** End Semester Examination **Total Credits: 28**

2.5 SCHEME OF FIFTH SEMESTER

BRANCH: Biomedical Engineering **YEAR: III** **SEMESTER V**

Sl. No	Subject Code	Subject Name	Periods (contact hour(s))			Evaluation Scheme (distribution of marks)					Credits
(THEORY)			**L**	**T**	**P**	**Internal Works**			**ESE**	**SUB TOTAL**	
						TA	**CT**	**TOT**			
1	BM-501	Bio-Transport Process	3	1	-	30	30	60	90	150	**4**
2	EC-502	Microprocessor	3	1	-	30	30	60	90	150	**4**
3	BM-503	Biomedical Signal Processing	3	1	-	30	30	60	90	150	**4**
4	BM-504	Biomedical Instrumentations-II	3	1	-	30	30	60	90	150	**4**
5	BM-505	Tissue Engineering	3	1	-	30	30	60	90	150	**4**
(**PRACTICAL / DRAWING / DESIGN**)											
6	EC-512	Microprocessor Laboratory	-	-	3	20	-	20	30	50	**2**
7	BM-513	Biomedical Signal Processing Laboratory	-	-	3	20	-	20	30	50	**2**
8	BM-514	Biomedical Instrumentation Laboratory-II	-	-	3	20	-	20	30	50	**2**
			15	**5**	**9**					**900**	**26**

Total Contact Hours: 29

L– Lecture **T –** Tutorial **P**– Practical **TA –** Teachers Assessment **Total Marks: 900**

CT– Class Test **TOT –** Total Internal Marks **ESE–** End Semester Examination **Total Credits: 26**

2.6 SCHEME OF SIXTH SEMESTER

BRANCH: Biomedical Engineering **YEAR: III** **SEMESTER VI**

Sl.No	Subject Code	Subject Name	Periods (contact hour(s))			Evaluation Scheme (distribution of marks)					Credits
(THEORY)			**L**	**T**	**P**	**Internal Works**			**ESE**	**SUB TOTAL**	
						TA	**CT**	**TOT**			
1	BM-601	Medical Imaging Techniques	3	1	-	30	30	60	90	150	**4**
2	BM-602	Modelling of Physiological Systems	3	1	-	30	30	60	90	150	**4**
3	BM-603	Artificial Organ and Rehabilitation Engineering	3	1	-	30	30	60	90	150	**4**
4	HU-604	Professional Ethics and IPR	3	1	-	30	30	60	90	150	**4**
5	BM-6051x	Elective I	3	1	-	30	30	60	90	150	**4**
(**PRACTICAL / DRAWING / DESIGN**)											
6	BM-612	Modelling of Physiological Systems Laboratory	-	-	3	20	-	20	30	50	**2**
7	BM-616*****	Hardware Design Project Laboratory	-	-	3	20	-	20	30	50	**2**
8	BM-617*****	Seminar & Group Discussion	-	-	3	20	-	20	30	50	**2**
9	GP-III	General Proficiency –III				-	-	50	-	50	**2**
		Total	**15**	**5**	**9**					**950**	**28**

Total Contact Hours: 29

L– Lecture **T –** Tutorial **P**– Practical **TA –** Teachers Assessment **Total Marks: 950**

CT– Class Test **TOT –** Total Internal Marks **ESE–** End Semester Examination **Total Credits: 28**

Elective-I:-

1) Bioinformatics
2) Fundamental of Bio-MEMS
3) Bio-Fluid Dynamics
4) Nuclear medicine ; Radiation and Safety

2.7 SCHEME OF SEVENTH SEMESTER

BRANCH: Biomedical Engineering **YEAR: VI** **SEMESTER VII**

Sl. No	Subject Code	Subject Name	Periods (contact hour(s))			Evaluation Scheme (distribution of marks)					Credits
(THEORY)			**L**	**T**	**P**	**Internal Works**			**ESE**	**SUB TOTAL**	
						TA	**CT**	**TOT**			
1	BM-701	Bio-Nanotechnology	3	1	-	30	30	60	90	150	**4**
2	BM-702	Hospital Management	3	1	-	30	30	60	90	150	**4**
3	BM-703	Medical Image Processing	3	1	-	30	30	60	90	150	**4**
4	HU-704	Industrial Economics and Management	3	1	-	30	30	60	90	150	**4**
5	BM-7051x	Elective-II(open)	3	1	-	30	30	60	90	150	**4**
(**PRACTICAL / DRAWING / DESIGN**)											
5	BM-711	Bio-Nanotechnology Laboratory	-	-	3	20	-	20	30	50	**2**
6	BM-713	Medical Image Processing Laboratory	-	-	3	20	-	20	30	50	**2**
7	BM-716*****	Industrial Tour	-	-	5	20	-	20	30	50	**3**
8	GP-IV	General Proficiency – IV				-	-	50	-	50	**2**
		Total	**15**	**5**	**9**					**950**	**29**

Total Contact Hours: 29

L– Lecture **T –** Tutorial **P**– Practical **TA –** Teachers Assessment **Total Marks: 950**

CT– Class Test **TOT –** Total Internal Marks **ESE–** End Semester Examination **Total Credits: 29**

Elective-II(open):-

1) Telemedicine.
2) Artificial Intelligence & its Applications in Biomedical Engineering.
3) Laser & fibre optics and its medical application.
4) Virtual Instrumentation.

2.8 SCHEME OF EIGHTH SEMESTER

BRANCH: Biomedical Engineering **YEAR: IV** **SEMESTER VIII**

Sl. No	Subject Code	Subject Name	Periods (contact hour(s))			Evaluation Scheme (distribution of marks)					Credits
(THEORY)			L	T	P	Internal Works			ESE	SUB TOTAL	
						TA	CT	TOT			
(PRACTICAL / DRAWING / DESIGN)											
1	BM-815	Major Project*	-	-	20	60	60	120	180	300	**15**
2	GP – V	General Proficiency – V				-	-	50	-	50	**2**
		Total	-	-	**20**					**350**	**17**

Total Contact Hours: 20

L– Lecture **T –** Tutorial **P**– Practical **TA –** Teachers Assessment **Total Marks: 350**

CT– Class Test **TOT –** Total Internal Marks **ESE–** End Semester Examination **Total Credits: 17**

In the case of projects/seminar/industrial tour, TA = Assessment from the Guide(s), CT = Internal Seminar, and ESE = Seminar with External/Inter Departmental Experts.

3. FIRST SEMESTER PAPERS

ES-101 ELEMENTS OF ENVIRONMENTAL SCIENCE **2-1-0 = 3**

Subject Code: *ES - 101.*
Subject Name: *Elements of Environmental Science.*
No. of Hours Per Week: *Lectures-2, Tutorial-1*
Marks Distribution: *Sessional Work = 40, End Semester Examination = 60.*
Questions to be set: *Six (one from each unit and remaining three from thecombination of more than one unit).*
Questions to be answered: *Any four.*
Duration of End Semester Examination: *Two and half Hours.*

UNIT - I

Environment, ecosystems and biodiversity: Concept of environment*:* components ofenvironment and their interactions; abiotic and biotic factors; Ecosystems: characteristic feature and structure and function of forest, grassland, desert and aquatic ecosystem (Ponds, streams, lakes, rivers, oceans, estuaries); Ecological pyramid; energy flow and nutrient cycling; Biodiversity: value of biodiversity; loss and conservation of biodiversity.

UNIT - II

Environmental problems and issues: Environmental problems and issues: greenhouse effect, ozone depletion, acid rain; Renewable and non-renewable resources; natural resources, associated problem and its conservation: forest, water, mineral, food, energy and land resources; environmental impact assessment; environment protection act.

UNIT - III

Environmental pollution and management: Environmental pollution: sources and types of air, water, soil, radioactive and noise pollution; Industrial pollutants and their impact on environment and human health; Toxicants and toxicity; toxic chemicals: heavy metals and pesticides; Safety and prevention of industrial pollution; bio-transformation and bioremediation;Aerobic and anaerobic treatment of waste water; waste management and cleaner production.

Text Books

1. W. P. Cunningham, and W.B. Saigo, Environmental Science, McGraw Hill, New York, 1999.
2. E. P. Odum, and G. W. Barrett, Fundamentals of Ecology, Thomson Asia Pvt. Ltd. Singapore, 2005.
3. E. Bacci, Contaminants in the Environment, CRC Press, 1994.
4. T. Ingold, The Perceptions of Environment, Routledge (Taylor and Francis Group), UK, 2000.

Reference Books

1. N. J. Sell, Industrial Pollution Control: Issues and Techniques, Wiley Pub., 1992.
2. Gilbert M. Masters, Introduction to Environmental Engineering and Science, 2/e, PHI, 1997.
3. Venugopal Rao, Textbook of Environmental Engineering, PHI, 2003.
4. S. S. Dara, A Text Book of Environmental Chemistry and Pollution Control, 7/e (revised), S. Chand and Co. Ltd., 2006.
5. C. Park, The Environment: Principles and Applications, Routledge (Taylor & Francis Group), UK, 2001.

MA-102 ENGINEERING MATHEMATICS – I **3-1-0 = 4**

Subject Code: *MA - 102.*
Subject Name: *Engineering Mathematics - I.*
No. of Hours Per Week: *Lectures-3, Tutorial-1*
Marks Distribution: *Sessional Work = 60, End Semester Examination = 90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any five.*
Duration of End Semester Examination: *Three Hours.*

UNIT -I

Functions, continuity and differentiability**,** graphs of f(x) = |x| + |x-1| + |x-2|; |x| - |y| = n. Properties of continuous functions on closed intervals.Intermediate value theorem andUniform continuity in [a, b].Functions of Bounded Variation, L'Hospital Rule (statementsonly with applications) and intermediateforms; Leibnitz's theorem.

UNIT-II

Mean value theorems and Taylor's theorem with Lagrange's form and Cauchy's form of remainders. Taylor's and Maclaurin's series of functions $\boldsymbol{log_e}(1+x)$, e^x , sin x, cos x; curvature, radius of curvature and centre of curvature of plane curves, Fundamental theorem of integral calculus. Reduction formula.

UNIT-III

Convergence of sequences, series and improper integral: Convergence of real sequences; monotone sequences, Cauchy's criterion, convergence of infinite series of real numbers.Cauchy's criterion, Convergence of improper integrals, Beta and Gamma functions and theirproperties.

UNIT-IV

*Ordinary Differential Equations***:** Order and degree, exactness and integrating factors. Solutions of first order and first degree O.D.E. of types- variable separable, homogeneous, linear, Bernoulli; and Second order L.D.E. $a_0y`` + a_1y` + a_1y = 0$ where's are constants, Nonlinear equations and Clairaut's equations.

Text Books

1. Mendelson, E, CALCULUS with 3000 examples, TMH, reprint 2010.
2. Kreyszig, E, Advanced Engineering Mathematics, 9/e, J. Wiley & Co., 2009.
3. S.C. Malik and SavitaArora, Mathematical Analysis, 6/e, Wiley Eastern Ltd., 2002.
4. B.S. Grewal, Higher Engineering Mathematics, 40/e, Khanna Publication, 2008.

Reference Books

1. B. K. Pal and K. Das, Engineering Mathematics-1 & 2, 3/e, U.N.Dhur& Sons Pvt. Ltd., 2010.
2. H.K. Dass, Advance Engineering Mathematics, 12/e, S. Chand & Co., 2010.
3. M. C. Potter, J. L Goldberg and E.F. Aboufadel, Advance Engineering Mathematics, 3/e,Oxford University Press, 2008.
4. B.S.Grewal, Engineering Mathematics, 12/e, Khanna Publications, 2009.

CH-103 ENGINEERING CHEMISTRY **3-1-0 = 4**

Subject Code: *CH - 103.*
Subject Name: *Engineering Chemistry.*
No. of Hours Per Week: *Lectures-3, Tutorial-1*
Marks Distribution: *Sessional Work = 60, End Semester Examination = 90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any five.*
Duration of End Semester Examination: *Three Hours.*

UNIT - I

Chemical Thermodynamics: Second law of thermodynamics, entropy and its physical significance, entropy change of ideal gases, free energy (Gibbs and Helmholtz), thermodynamic properties for reversible and irreversible processes, equilibrium constant from thermodynamic considerations, Maxwell's relationships, Gibbs-Helmholtz equation, Clapeyron-Clausius equation, concept of chemical potential with examples, Van't Hoff reaction isotherm, third law of thermodynamics and its applications. *Fundamentals of Instrumental analysis:* UV-VIS, IR and Fluorescence spectrophotometry.

UNIT - II

Organic Chemistry: Structures and functions of biologically important molecules (Carbohydrates, Amino acids, Proteins and Nucleic acids), E-Z and R-S systems of nomenclature of organic molecules, conformation and conformation analysis for certain organic systems. *Polymers:* Classification and structures of polymers, commercially important polymers like Teflon, Bakelite, nylon, polyester, polyurethane, Silicon resins, etc.).

UNIT - III

Electrochemistry: Behaviour of strong electrolytes with concentration, electrochemical cells, EMF and applications of EMF measurements, commercially important cells and corrosion (its chemistry and remedial methods). *Chemical Kinetics:* General discussion on the reactions of different orders including their rate laws with examples, problems based on first and second order reactions, pseudo-uniorder reactions, theories of reaction rates (collision and transition state theories), activation energy and catalytic reactions. Lasers in chemistry and its applications.

UNIT - IV

Coordination Chemistry: Structure of coordination compounds corresponding to coordination no. up to 6, types of ligands, EAN, isomerism, bonding in coordination compounds (VBT and MOT), Application of organometallic chemistry in biomolecules (Vitamin B12 and Haemoglobin).
Water and its hazard in industry – Hard and soft waters, disadvantages of hard water in industries, estimation of hardness of water, treatment of industrial water (external and internal methods).

Text Books:

1. Prakash, Tuli, Basu and Madan, Advanced Inorganic Chemistry, Vol. I & II, (Diamond Ed), S. Chand, reprinted, 2006.
2. Morrison and Boyd, Organic Chemistry, 6/e, Prentice Hall of India, reprinted, 2006.
3. Jain and Jain, Engineering Chemistry, Dhanpat Rai Publishing Co., 2008.
4. Levine, Physical Chemistry, 5/e (7th reprint), Tata McGraw Hill, 2006.

Reference Books:

1. Shriver, Atkins and Langford, Inorganic Chemistry, 2/e, ELBS, 1994.
2. S.H.Pine, Organic Chemistry, 5/e (special Indian ed.), TMH, 2007.
3. Banwell and McCash, Fundamentals of Molecular Spectroscopy, 4/e, Tata Mc-Graw Hill, 1962.
4. Cotton, Wilkinson and Gaus, Basic Inorganic Chemistry, 3/e, John Wiley & Sons, Inc., 1996.
5. L. Finar, A Textbook of Organic Chemistry, 6/e, Vol. I & II, ELBS, 2006.

Subject Code: *IT - 104.*
Subject Name: *Computer Systems and Programming.*
No. of Hours Per Week: *Lectures-3, Tutorial-1*
Marks Distribution: *Sessional Work = 60, End Semester Examination = 90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any five.*
Duration of End Semester Examination: *Three Hours.*

UNIT - I

Digital computer fundamentals: Functional components of computer, Von Newman Architecture, Algorithm and flowcharts, Data representation, Programming languages, Function of system software.

UNIT - II

Imperative programming (Using C): Overview of C, Constants, Variables and Data Types, Operators and Expressions, Input and Output Operations, Branching and looping operation.

UNIT - III

Functions: Defining a function, accessing a function, passing arguments to a function, Specifying argument data types, function prototypes and recursion, storage classes. *Arrays***:** Defining an array, processing an array, passing arrays to a function, multidimensional arrays, strings, string handling functions.

UNIT - IV

Structures and Unions: Defining and processing of structure and union, Array of structure, array within structure, passing of structure as argument.
*Pointers***:** Fundamentals, pointer declarations, passing pointers to a function, pointer and one dimensional arrays, pointer as function arguments, Functions returning Pointer, Pointer to functions, pointers and structures.

UNIT - V

File Management: Introduction, Defining and Opening a File, Closing a File, Input/output Operations on Files, Error Handling during I/O Operations, Random Access to Files, command *line Arguments*.

Text Books

1. V. Rajraman, Fundamental of Computer, 4/e, PHI, 2006.
2. E. Balaguruswami, Programming in ANSI C, 2/e, Tata McGraw Hill, 2004.

Reference Books

1. Y. Kanetkar, Let us C, BPB Publication, 2004.
2. A. Kelley and I. Pohl, A Book on C, 4/e, Pearson Education, 1998.
3. B. W. Kernighan and D. Ritchie, The C Programming Language, 2/e, PHI, 2005.

EC - 105 BASIC ELECTRONICS **3-1-0 = 4**

Subject Code: *EC - 105.*
Subject Name: *Basic Electronics.*
No. of Hours Per Week: *Lectures-3, Tutorial-1*
Marks Distribution: *Sessional Work = 60, End Semester Examination = 90.*
Questions to be set: *Eight (one from each unit and remaining four from thecombination of more than one unit).*
Questions to be answered: *Any five.*
Duration of End Semester Examination: *Three Hours.*

UNIT – I

Passive components: Resistors, capacitors and inductors: types and characteristics and their applications.
Semiconductors: Energy bands in silicon, intrinsic and extrinsic, carriers transport in silicon: diffusion current, drift current, mobility and resistivity. Generation and recombination of carriers, Semiconductor materials
PN junction diode: General idea of a PN junction diode, Reverse and forward biased characteristics, Transition capacitance and diffusion capacitance.

UNIT – II

PN Junction diode applications: Half wave rectifier, full wave centre- tapped and bridge rectifier Clipping and clamping circuits.
Introduction to Special purpose diode characteristics and applications: Zener diode, Photo Diode, Varactor diode, Light emitting diode, Schottky diode, Tunnel diode.

UNIT – III

BJT, FET (JFET & MOSFET) and UJT: Construction, symbols, principle of operation, different configurations, study of characteristics, limitations and applications, Application of BJT as amplifiers.
Biasing and stabilization of BJT: Q point, Graphical analysis (DC and AC load line), fixed bias, collector bias, self bias.

UNIT – IV

Digital Electronics: Number systems and codes, logic gates, Boolean theorems, De-Morgan's theorems, Boolean algebra, minimization of Boolean functions; Karnaugh map up to four variables.

Text Books

1. Boylestead and Nashelsky, Electronic Devices and Circuits Theory, 9/e, PHI, 2006.
2. Bernard Grob and Mitchel Schultz, Basic Electronics, 9/e, TMH, 2003.
3. Morris Mano, Digital Design, 3/e, PHI, 2006.
4. J. Millman and C. C. Halkias, Integrated Electronics, 42nd Reprint, TMH, 2006.

Reference Books

1. P. Malvino, Electronic Principles, 6/e, TMH, 1998.
2. R. P. Jain, Modern Digital Electronics, 3/e, TMH, 2003.
3. R. J. Tocci, Digital Systems, 6/e, PHI, 2001.

CH - 113 ENGINEERING CHEMISTRY LABORATORY **0-0-3 = 2**

Subject Code: *EC - 113.*
Subject Name: *Engineering Chemistry Laboratory.*
No. of Hours Per Week: *Practicals-3.*
Marks Distribution: *Sessional Work = 20, End Semester Examination = 30.*
Minimum number of Experiments to be carried out: *Eight.*
***Question to be answered*:** *One experiment will be allotted to a student on lottery basis.*
Duration of End Semester Examination: *Four Hours.*

List of Experiments:-

1. Volumetric estimation of Mg2+ and Ca2+ ions by EDTA titration (Hardness of water).
2. Volumetric estimation of Fe2+ ions by permanganatometry.
3. Preparation of an inorganic complex like, potassium chlorochromate, sodium Cobalt nitrate, Fe(acac)3, etc.
4. Determination of concentration of the given liquid mixture by viscosity measurement.
5. Determination of partition-coefficient of iodine between carbon tetrachloride and water.
6. Determination of integral heats of dilution of the sulphuric acid solutions, and to determine the strength of the given unknown acid solution.
7. Standardisation of a strong acid by conduct metric titration with a strong base.
8. Experimental verification of Hasselbach-Henderson equation by pH measurement for a buffer mixture.
9. Determination of rate constant of the acid-catalysed hydrolysis of methyl acetate.
10. Verification of Beer-Lambert's law with potassium permanganate and the estimation of potassium present in the given solution.
11. Systematic qualitative analysis of organic compounds containing one functional group :
a. Detection of element out of N, S, Cl, Br, I
b. Detection of a functional group out of -COOH, -NO_2, -OH (alcoholic or phenolic),>CO carbonyl, -NH2 group.
12. Synthesis and characterization (by m.p. method) of para-nitro acetanilide.

Text Books

1. Pandey, Bajpai and Giri, Practical Chemistry, 8/e (reprinted), S. Chand & Co. Ltd., 2006.
2. Gurtu & Kapoor, Advanced Experimental Chemistry, Vol. I – III, 4/e (reprinted), S. Chand & Co. Ltd., 1989.

Reference Books

1. Vogel's Textbook of Quantitative Chemical Analysis, 5/e, ELBS, 1991.
2. Vogel's Textbook of Practical Organic Chemistry, 5/e, ELBS, 1996.

IT –114COMPUTER PROGRAMMING LABORATORY **0-0-3 = 2**

Subject Code: *IT - 114.*
Subject Name: *Computer Programming Laboratory.*
No. of Hours Per Week: *Practicals-3.*
Marks Distribution: *Sessional Work = 20, End Semester Examination = 30.*
Minimum number of Experiments to be carried out: *Eight.*
***Question to be answered*:** *One experiment will be allotted to a student on lottery basis.*
Duration of End Semester Examination: *Four Hours.*

List of Programs

1. Assignments on Operators and Expressions: At least three C programs using operators and expressions.
2. Assignments on Branching: At least five C programs using if, switch-case construct of C.
3. Assignments on Looping: At least three C programs (each), incorporating for loop, while loop and do-while loop.
4. Assignments on Array: At least three C programs using array (1D and 2D)
5. Assignments on String: string manipulation and use of standard library functions in C.
6. Assignments on Function: At least three C programs using function, Demonstration call-by-value and call-by-address, passing array (1D and 2D) to a function, at least two C programs related to recursive function.
7. Assignments on Pointer: At least three C programs using pointer, function and array.
8. Assignments on Structure & Union: At least one C program using structure, demonstration of difference between structure and union.
9. Assignments on File handling and Commands line arguments: C programs involving opening, closing, reading/writing a file. Copy the content of one file to another file using commands line, arguments.

Text Books

1. B. S. Gotfried, Programming in C, Schuam Outline Series, TMH, 2005.

EC - 115 BASIC ELECTRONICS LABORATORY **0-0-3 = 2**

Subject Code: *EC - 115.*
Subject Name: *Basic Electronics Laboratory.*
No. of Hours Per Week: *Practicals-3.*
Marks Distribution: *Sessional Work = 20, End Semester Examination = 30.*
Minimum number of Experiments to be carried out: *Eight.*
***Question to be answered*:** *One experiment will be allotted to a student on lottery basis.*
Duration of End Semester Examination: *Four Hours.*

List of Experiments:-

1. To Study the VI Characteristics of Silicon Diode.
2. To Study the VI Characteristics of Zener Diode.
3. Design and Analysis of a Half wave Rectifier using Diode.
4. Design and Analysis of a centre-tap Full wave Rectifier using Diodes
5. Design and Analysis of a Bridge Rectifier Circuit.
6. Design and Analysis of a Clipping Circuit with one voltage source.
(*Different possible configurations*)
7. Design and Analysis of a Clipping Circuit with two voltage source.
(*Different possible configurations*)
8. Design and Analysis of a Clamper Circuit.
9. Analysis of the characteristics of BJT (CE and CB mode)
10. Design and Analysis of fixed bias circuit using NPN transistor (DC)
11. Design and Analysis of emitter bias circuit using NPN transistor (DC)
12. Study of the characteristics of JFET.
13. Study of the characteristics of MOSFET.
14. Verification of truth tables of logic gates.

Text Books

1. Boylestead and Nashelsky, Electronic Devices and Circuits Theory, 9/e, PHI, 2006.
2. R. P. Jain, Modern Digital Electronics, 3/e, TMH, 2003.

CE - 116 ENGINEERING GRAPHICS **0-0-3 = 2**

Subject Code: *CE - 116.*
Subject Name: *Engineering Graphics.*
No. of Hours Per Week: *Practicals-3.*
Marks Distribution: *Sessional Work = 20, End Semester Examination = 30.*
Minimum number of Experiments to be carried out: *Eight.*
***Question to be answered*:** *One experiment will be allotted to a student on lottery basis.*
Duration of End Semester Examination: *Four Hours.*

List of Drawing Plates/Sheets

1. Introduction of Drawing (Sheet layout and Sketching, Lines, Lettering and Dimensioning).
2. Geometrical Constructions (Bisecting a lines, Perpendicular lines, divide a lines, construction of polygons).
3. Conics and Engineering Curves (Ellipse, Parabola, Hyperbola).
4. Conics and Engineering Curves (Cycloid, Epicycloid, Hypocycloid, Trochoid, Involute).
5. Projection of Points.
6. Projection of Lines.
7. Projection of Planes.
8. Projection of Solid (Cube, Prism, Pyramids).
9. Projection of Solid (Cylinder, Cone and Sphere).
10. Isometric projection of solids (Prisms, Pyramids, Cylinders, Cone and Sphere).
11. Development of Surfaces (Truncated Cylinder, Square Prism, Pyramid, Truncated Cone).
12. Introduction to CAD Tools (Scale, Units, Draw, Modifying, Dimension, Sheet Layout, Plotting).

Text Books

1. T. E. French, C.J. Vierck and R. J. Foster, Engineering Drawing and Graphics Technology**,** TMH, 1987.
2. N. D. Bhatt and V.M. Panchal, Elementary Engineering Drawing, Charotar Publishing House, 1996.

Reference Books

1. K. Venugopal, Engineering Drawing and Graphics, New Age, 2005.
2. Dhananjay A. Johle, Engineering Drawings, McGraw Hill Education Pvt. Ltd., 2008.

4. SECOND SEMESTER PAPERS

HU - 201 PROFESSIONAL COMMUNICATION SKILLS **2-1-0 = 3**

Subject Code: *HU -201.*
Subject Name: *Professional Communication Skills.*
No. of Hours Per Week: *Lectures-2, Tutorial-1*
Marks Distribution: *Sessional Work = 40, End Semester Examination = 60.*
Questions to be set: *Six (one from each unit and remaining three from the combination of more than one unit).*
Questions to be answered: *Any four.*
Duration of End Semester Examination: *Two and half Hours.*

UNIT I

General Principles of Communication and Oral Communication:
The Process of Communication, Principles of Communication (communication barriers, levels of Communication, Communication network, verbal, non-verbal) and Professional Communication. The Speech Mechanism, IPA symbols (vowel and consonant sounds), minimal pairs, word transcription, stress and intonation, active listening, types of listening, traits of a good listener, active versus passive listening.

UNIT II

Constituents of Effective Writing and Vocabulary:
The sentence and its parts, articles, the verb phrase, tense and aspect, the active and passive, the adjective, interrogative and negative sentences, concord, preposition. Paragraph development, summary writing and reading comprehension, word formation processes: affixation, compounding, converting, use of words in different parts of speech, idioms and phrases.

UNIT III

Business Correspondence and Communication Strategies:
Characteristics of Business Letters, Drafting: Bio-data/ Resume/Curriculum vitae (theory).
Report Writing**:** Structure, Types of Reports (theory). Presentation skills, public speaking and group discussion (theory) and soft skills (theory).

Text Books

1. Das, B. K, Samantray K., et.al., An Introduction to Professional English and Soft Skills, CUP, New Delhi, 2009.
2. Sharma R.C, Mohan K., Business correspondence and Report Writing, Tata Mcgraw Hill, New Delhi, 2002.
3. A. Doff, C. Jones, Language In Use, Upper- Intermediate Classroom Book, Classroom Book, CUP, New Delhi, 2004.

Reference Books

1. O'Connor, J. D., Better English Pronunciation, CUP, London, 2006.
2. Patnaik, P., Group Discussion and Interview Skills, CUP, New Delhi, 2011.
3. Greenbaum, Sidney, Oxford English Grammar, OUP, 1996.
4. Seely, John, Oxford Guide to Effective Writing and Speaking, OUP, India, 2000.
5. Eastwood, John, Oxford guide to English Grammar, OUP, India, 1994.

MA - 202 ENGINEERING MATHEMATICS - II **3-1-0 = 4**

Subject Code: *MA - 202.*
Subject Name: *Engineering Mathematics - II.*
No. of Hours Per Week: *Lectures-3, Tutorial-1*
Marks Distribution: *Sessional Work = 60, End Semester Examination = 90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any five.*
Duration of End Semester Examination: *Three Hours.*

UNIT - I

*Functions of several variables***:** Partial derivatives, Chain rule, Standard Jacobians for change of variables. Gradient and directional derivatives, Tangent planes and normal, Exact differentials, Euler's theorem on homogeneous functions, Repeated and multiple integrals, maxima and minima for several variables, method of Lagranges multipliers.

UNIT - II

*Vector Calculus***:** Vector valued function of one or more variables (up to 3), derivatives of such a function of one variable. Gradient of a scalar valued function. Geometrical andphysical properties of gradient. Divergence and Curl of vector valued functions. Line, surface, and volume integrals. Green's theorem, Gauss's divergence theorem and Stoke's theorem in Cartesian coordinates, Spherical and Cylindrical polar coordinates (statementsonly with applications).

UNIT - III

Complex Analysis: Analytic functions, Cauchy-Riemann equations, Laplace equations.Elementary functions, Conformal mappings. Cauchy's integral theorem, Cauchy's integralformula, Taylor series and Laurent series. Residues and its applications to evaluating realintegrals.

UNIT - IV

Laplace and Fourier Transforms: Laplace transforms. Inverse transform. Shifting on the s-and t-axes, convolutions, partial fractions. Fourier series and Fourier transforms. Solutions of ordinary as well as partial differential equations by Laplace and Fourier transforms.

Text Books

1. Mersden, J.E., Basic Complex Analysis, 4/e, W. H. Freeman, Houndmills, Hampshire, 2008.
2. Spiegel, Fourier Analysis with application and Laplace Transforms, TMH, reprint, 2010.
3. E. Kreyszig, Advance Engineering Mathematics, 9/e, J. Willey & Co, 2009.
4. B. C. Das and B.N. Mukherjee, Differential Calculus, 5/e, U. N. Dhur & Sons Pvt. Ltd., 2010.

Reference Books

1. S. Narayan, Vector Calculus, S. Chand & Co, 1974.
2. T. M. Apostol, Calculus, 2/e, J. Willey, 1969.
3. Schuams outline: Complex Variable, TMH, 2009.
4. B. K. Pal and K. Das, Engineering Mathematics, Vol. 1 & 2, 3/e, U .N. Dhur & Sons Pvt. Ltd, 2010.

PH - 203 ENGINEERING PHYSICS **3-1-0 = 4**

Subject Code: *PH - 203.*
Subject Name: *Engineering Physics.*
No. of Hours Per Week: *Lectures-3, Tutorial-1*
Marks Distribution: *Sessional Work = 60, End Semester Examination = 90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any five.*
Duration of End Semester Examination: *Three Hours.*

UNIT – I

Classical mechanics-I, Acoustic and General Properties of matter: Component of velocity and acceleration in two dimensions in Cartesian and polar coordinates. Moment of inertia, theorems of parallel and perpendicular axes (proof) for both laminar and three dimensional bodies. Compoun dpendulum and its theory. Free and forced vibration, resonance and sharpness of resonance, Reverberation, Sabine's law of reverberation.Ultrasonic, production and applications.Problems. Interrelation of elastic constants. Torsion of a cylinder. Bending of beams- cantilever and beam supporting at both ends, Problems.

UNIT – II

Electromagnetism and Physical optics: Gradient, divergence, curl; Electrostatic field **E** and potential φ, their relation. Short electric dipole, Gauss law and its applications for finding **E** for various symmetric charge distribution, Maxwell's equations (statement and significance).
Interference: Newton rings: theory and wavelength determination Diffraction: Fraunhofer diffractions at a single slit, Fresnel half period zone, zone plate. Polarization, half and quarter wave plates, Problems.

UNIT – III

Quantum Mechanics and Solid State Physics: De Broglie's hypothesis, Uncertainty principle, Schrödinger's equations, particle in a one dimensional box of rigid walls. Problems. Free electron gas in one and three dimensions, F-D distribution function- its variation with energy at different temperatures: Band theory of solids (a qualitative treatment), distinction of metals, semimetals and insulators. Preliminary ideas of superconductivity, Problems.

UNIT – IV

Atomic, molecular and nuclear Physics: compton Effect and Compton shift, vector atom model; one electron atomic spectra, molecular spectra and selection rules. Brief theory of laser, spontaneous emission, stimulated emission and absorption, applications of laser. Problems. Nuclear reaction and Q value, Nuclear fission, chain reaction, nuclear fusion and stellar energy, Problems.

Text Books

1. Hugh D. Young and Lewis Ford, University Physics with Modern Physics, 12/e, Pearson, 2008.
2. P. K. Chakrabarthy, Mechanics and General Properties of Matter, Books & Allied Ltd., 2001.
3. G. S. Raghuvanshi, Engineering Physics, Prentice Hall of India Pvt Ltd., 2008.
4. H. K. Malik and A. K. Singh, Engineering Physics, Tata McGraw Hill, New Delhi, 2010.

Reference Books

1. H. J. Pain, The Physics of Vibrations and Waves, 6/e, Wiley Student Edition, 2005.
2. G. R. Fowles and G L Cassiday, Analytical Mechanics, 7/e, Ceingage Learning, Indian Edition,2005.
3. P. V. Naik, Principles of Physics, Prentice Hall of India Pvt Ltd., 2000.
4. A. Beiser, Perspective of Modern Physics, McGraw- Hill, 1969.

ME - 204 ENGINEERING MECHANICS **3-1-0 = 4**

Subject Code: *ME - 204.*
Subject Name: *Engineering Mechanics.*
No. of Hours Per Week: *Lectures-3, Tutorial-1*
Marks Distribution: *Sessional Work = 60, End Semester Examination = 90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any five.*
Duration of End Semester Examination: *Three Hours.*

UNIT-I

Force Systems: Moment of a force about a point and about an axis; couple moment; reduction of a force system to a force and a couple. Equilibrium: Free body diagram; equations of equilibrium; problems in two and three dimensions; plane frames and trusses.

UNIT–II

Friction: Laws of Coulomb friction, problems involving large and small contact surfaces; square threaded screws; belt friction; rolling resistance. *Properties of Areas*: Moments of inertia and product of inertia of areas, polar moment of inertia, principal axes and principal moments of inertia.

UNIT–III

Kinematics and Kinetics of particles: Particle dynamics in rectangular coordinates cylindrical coordinates and in terms of path variables; central force motion.

UNIT–IV

Rigid **Body** *Dynamics*: Relative velocity, Translation, Pure rotation and plane motion of rigid bodies, D'Alembert's principle, linear momentum, principle of conservation of momentum, Impact of solid bodies, work, energy, power, principle of conservation of energy.

Text Books

1. R. K. Bansal, A textbook of Engineering Mechanics, Laxmi Publication, 1992.
2. I. H. Shames, Engineering Mechanics: Statics and Dynamics, 4/e, PHI, 1996.
3. F. P. Beer and F. R. Johnston, Mechanics for Engineering, TMH, 1987.
4. S. Ramamurtham, Engineering Mechanics, Dhanpatrai Publishing Company, 2003.

Reference Books

1. R.C. Hibbler, Engineering Mechanics: Static, McMillan, 1998.
2. R.C. Hibbler, Engineering Mechanics: Dynamic, PHI, 1997.
3. K.L. Kumar, Engineering Mechanics, S. Chand, 1997.
4. Timoshenko and Young, Engineering Mechanics, McGraw Hill, 1956.
5. A. Nelson, Engineering Mechanics-Statics & Dynamics, McGraw Hill Publications, reprint2010.

EE – 205 BASIC ELECTRICAL ENGINEERING 3-1-0 = 4

Subject Code: *EE - 205.*
Subject Name: *Basic Electrical Engineering.*
No. of Hours Per Week: *Lectures-3, Tutorial-1*
Marks Distribution: *Sessional Work = 60, End Semester Examination = 90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any five.*
Duration of End Semester Examination: *Three Hours.*

UNIT – I

Engineering Circuit Analysis: Circuit elements, Ohm's law, Kirchoff's law, Nodal Analysis, Mesh Analysis, Source transformations. Linearity and Superposition, Thevenin and Norton Theorems, Maximum power transfer theorem, Star-Delta and Delta-Star Conversion.

UNIT – II

Simple RL and RC Circuits, Unit Step Forcing Function, source free RLC Circuits, Sinusoidal Forcing Function, Complex Forcing Function, Phasor Concept, Impedance and Admittance, Phasor diagrams, Response as a Function of, Instantaneous Power, Average Power, RMS values of Current and Voltage, Apparent Power and Power Factor, Complex Power, Introduction to Three Phase Circuits.

UNIT – III

DC Machines: Principle of DC Generator, Methods of excitation, Characteristics and Applications, Principle of DC Motor, Types, Speed – Torque Characteristic, Speed Control. Transformers: Working principle of Transformers, Equivalent Circuit, Transformer tests.

UNIT –IV

Three Phase Induction Motor: Construction, Production of rotating field, Slip, Torque and Slip. Single Phase Induction Motor: Double field revolving theory, Shaded Pole single phase induction motor. Stepper Motors.

Text Books

1. W. H. Hayt, J.E. Kemmerly and S. M. Durbin, Engineering Circuit Analysis, 6/e, TMH, 2006.
2. V. Del Toro, Electrical Engineering Fundamentals, PHI, 1994.
3. D. P. Kothari, I. J. Nagrath, Theory and Problems of Basic Electrical Engineering, PHI, 2004.
4. B. L. Thereja and A. K. Thereja, Electrical Technology, Vol-II, S. Chand, Reprint 2006.

Reference Books

1. V. Valkenburg, Network Analysis, 3/e, PHI, 2005.
2. J. A. Edminister, Electric circuits, 2/e, Eleventh reprint, TMH, 1997.
3. D. Roy Choudhury, Networks and Systems, New Age Publishers, 1998.

HU - 211 DIGITAL ENGLISH LANGUAGE LABORATORY **0-0-3 = 2**

Subject Code: *HU - 211.*
Subject Name: *Digital English Language Laboratory.*
No. of Hours Per Week: *Practicals-3.*
Marks Distribution: *Sessional Work = 20, End Semester Examination = 30.*
Minimum number of Experiments to be carried out: *Eight.*
***Question to be answered*:** *One experiment will be allotted to a student on lottery basis.*
Duration of End Semester Examination: *Four Hours.*

List of Practical Exercises:-

1. Articulation and practice of Vowel sounds and Diphthongs.
2. Articulation and practice of consonant sounds.
3. Practice word and sentence stress with intonation.
4. Practice Oral Presentation skills.
5. Handling telephone calls.
6. Vocabulary practice through situational dialogues.
7. Reporting.
8. Debating.
9. Appearing for personal interview.
10. Writing E-mails.
11. Writing business letter.
12. Drafting Curriculum Vitae/ Resume/Bio-data.
13. Using situational dialogues in situations like requests, asking and giving directions, leaving a message.

Resource Materials

A. *Books*:

1. Jones, Daniel, Cambridge English Pronouncing Dictionary with CD, New Delhi, 2009.
2. Roach, Peter, English Phonetics and Phonology with CD, CUP, India, 1983.
3. Cambridge Learners Dictionary with CD, CUP, New Delhi, 2009.
4. Rajeevan, Dutt, Sasikumar, A course in Listening and Speaking I & II with CD**,** CUP,
5. New Delhi, 2007.
6. Rajeevan and Dutt, Basic Communication Skills, CUP, New Delhi, 2007.

B. Software: Orell Digital Language Lab Software.

PH - 213 ENGINEERING PHYSICS LABORATORY **0-0-3 = 2**

Subject Code: PH - 213.
Subject Name: Engineering Physics Laboratory.
No. of Hours Per Week: Practicals-3.
Marks Distribution: Sessional Work = 20, End Semester Examination = 30.
Minimum number of Experiments to be carried out: Eight.
Question to be answered: One experiment will be allotted to a student on lottery basis.
Duration of End Semester Examination: Four Hours.

List of Experiments:-

1. To determine the acceleration due to gravity by bar pendulum/Kater's pendulum.
2. To determine the Young's modulus of a wire by micrometres method/ of a bar by flexural method.
3. To determine rigidity modulus of a wire by statical method/dynamical method.
4. To determine the focal length & power of a concave lens by combination with auxiliary convex lens by the displacement method.
5. To find the wavelength of monochromatic light by using Newton's ring method.
6. To determine the wavelength of sodium light by Michelson's interferometer.
7. To determine the wavelength of prominent lines of mercury by plane diffraction grating.
8. To determine he specific rotation of sugar solution by polarimeter.
9. To determine the magnetic moment of a bar magnet (M) and the earth's horizontal intensity (H) (by deflection and vibration magnetometers).
10. To determine the resistance per unit length of a meter bridge wire by Carey- Foster Method.
11. To study decay of current in RC circuit.
12. To determine frequency of a tuning fork by Melde's method.
13. To determine the thermal conductivity of a bad conductor Lee's method.
14. To obtain the hysteresis curves (B-H) for a ferromagnetic material (thin rod or wire) on a CRO using solenoid and then to determine the related magnetic constants.
15. To study the Hall Effect and determine the Hall Coefficient.
16. To determine the Planck's constant by a Photocell.
17. To determine the e/m value of an electron by any method.

Text Books

1. Samir Kumar Ghosh, A Text book of Practical Physics, New Central Book Agency,
2. Kolkata, 2006.
3. Gupta and Kumar, Practical Physics, ProgatiPrakashan, Meerut, U.P., 2005.
4. Harnam Singh, B.Sc. Practical Physics, S Chand & Company, 2004.
5. C. L. Arora, Advance B.Sc. Practical Physics, S. Chand, 2004.

EE - 215 BASIC ELECTRICAL ENGINEERING LABORATORY **0-0-3 = 2**

Subject Code: *EE - 215.*
Subject Name: *Basic Electrical Engineering Laboratory.*
No. of Hours Per Week: *Practicals-3.*
Marks Distribution: *Sessional Work = 20, End Semester Examination = 30.*
Minimum number of Experiments to be carried out: *Eight.*
***Question to be answered*:** *One experiment will be allotted to a student on lottery basis.*
Duration of End Semester Examination: *Four Hours.*

List of Experiments:-

1. To verify Thevenin's theorem.
2. To verify Norton's theorem.
3. To verify Maximum Power Transfer theorem.
4. To verify that the phasor sum of currents at any junction in an A.C. circuit is zero.
5. To measure Power and power factor of the load by three ammeters method.
6. To measure Power and power factor of the load by three voltmeters method.
7. To perform Open circuit and Short Circuit Tests on a single phase transformer.
8. To determine the Open Circuit Characteristic of D.C. Generator
9. To measure and control the Speed of D.C. motors using Tachometer.
10. To calibrate an ammeter as voltmeter.

Text Books

1. W. H. Hayt, J. E. Kemmerly and S. M. Durbin, Engineering Circuit Analysis, 6/e, TMH, 2006.
2. B. L. Thereja and A. K. Thereja, Electrical Technology, Vol-II, S. Chand & Co, Reprint, 2006.

ME - 216 WORKSHOP PRACTICE **0-0-3 = 2**

Subject Code: *ME - 216.*
Subject Name: *Workshop Practice.*
No. of Hours Per Week: *Practicals-3.*
Marks Distribution: *Sessional Work = 20, End Semester Examination = 30.*
Minimum number of Experiments to be carried out: *Eight.*
***Question to be answered*:** *One experiment will be allotted to a student on lottery basis.*
Duration of End Semester Examination: *Four Hours.*

I. Theory (*about various components involved in Workshop Practice)*
(a) Carpentry: Timber, definition, Engineering applications, seasoning and preservation, plywood and ply-boards
(b) Metal Joining: Definitions of welding, brazing and soldering processes, and their applications. Oxy-acetylene glass welding process, equipment and techniques, types of flames and their applications. Manual metal arc welding technique and equipment, AC and DC welding, electrodes, constituents and functions of electrode coating. Welding positions. Types of weld joint. Common welding defects such as cracks, undercutting, slag inclusion, porosity.
(c) Metal Cutting: Introduction to machining and common machining operations. Cutting tool materials. Definition of machine tools, specification and block diagram of lathe, shaper, milling, drilling machine and grinder. Common lathe operations such as turning, parting, chamfering and facing.Quick return mechanism of shaper. Difference between drilling and boring. Files-material and classification.

II. Experiments: *At least eight (8) experiments need to be conducted*
List of Jobs to be made in the Workshop
(a) Carpentry:
1. T-Lap & L-joints, *2.* Bridle joint
(b) Metal Joining: Welding Practice.
1. Gas welding practice on mild steel flat
2. Lap joint by Gas welding
3. MMA welding practice by students
4. Square butt joint by MMA Welding
5. Lap joint by MMA Welding
6. Demonstration of brazing
7. Tin smithy for making mechanical joints and soldering of joints
(c) Metal Cutting:
1. Job on lathe with one step turning and chamfering operations
2. Job on shaper and milling machine for finishing two sides of a job
3. Drilling two holes of size 5 and 12 mm diameter on job used / to be used for shaping
4. Grinding a corner of above job on bench grinder
5. Finishing of two sides of a square piece by filing.

Text Books

1. HajraChoudhary, Elements of Workshop Technology, Vol. I & II, Media Promoters & Publishers, 2002.
2. M. L. Begeman and B.H. Amstead, Manufacturing Process, John Wiley, 1968.
3. W. A. J. Chapman and E.Arnold, Workshop Technology, Vol. I &III, Viva Low Priced Student Ed, 1998.
4. B. S. Raghuwanshi, Workshop Technology, Vol. I & II, DhanpatRai and Sons, 1998.
5. Khanna, O. P, Workshop Technology, DhanpatRai Publications, 1998.
6. S. Crawford, Basic Engineering Processes, Hodder& Stoughton, 1985.
7. T. Jeyapoovan, Workshop Practics, Vikas Publication, 2001.
8. Juneja B. L, Fundamentals of Metal Cutting & Machine Tools, New Age International, 1995.
9. Kuppuswamy, G, Principle of Metal Cutting, Universities Press/Orient Longman, 1996.

5. THIRD SEMESTER PAPERS

MA – 301 ENGINEERING MATHEMATICS – III **3-1-0 = 4**

Subject Code: *MA - 301.*
Subject Name: *Engineering Mathematics - III.*
No. of Hours Per Week: *Lectures-3, Tutorial-1.*
Marks Distribution: *Sessional Work = 60, End Semester Examination =90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any five.*
Duration of End Semester Examination: *Three Hours.*

UNIT I

***Introductory Linear Algebra*:** Vector spaces (over the field of real and complex numbers).Matrices and determinants, linear transformation. Rank of system of linear equations and their solutions. Inverse of matrix. Equivalent, Elementary, Echelon, normal matrices. Eigen values and eigen vectors. Similarity Matrices. Bilinear and quadratic forms.Diagonalisation of Hermitian matrices, Matrices in Physical science- Rotational, Pauli spin, Dirac matrices.

UNIT II

***Applied Linear Algebra*:** Classification of quadrics in space. Variation of Parameters for second order linear O.D.E. with variable coefficients, Ordinary linear differential equations of nth order, solutions of homogeneous equations, Operator method. Methods of undetermined coefficients and variation of parameters (simple problems only), Applications to physical sciences and engineering problems. Frobenius method.

UNIT III

***Numerical Methods – I*:** Bisection method, Newton-Rapson's and Secant methods for roots of nonlinear equations. Polynomial interpolation, divided differences, summation of series, errors in polynomial interpolation, interpolation by spline functions. Numerical integration, trapezoidal and Simpson's rules, error formulae, Gaussian quadrature, numerical differentiation.

UNIT IV

***Numerical Methods – II*:** Solution of linear systems, Gaussian elimination, LU factorization, ill-conditioning and error bounds, Eigen value problems, f-computation of eigen values and eigen vectors by power and inverse iterations.

Text Books

1. T.M. Apostol, Calculus, Volume II, 2/e, Wiley, 1969.
2. Krishnamurty, Mainra and Arora, Linear Algebra, Affiliated East-West Pvt. Ltd., 2007.
3. K.E. Atkinson, Introduction of Numerical Analysis, 2/e, John Wiley, 1989.

Reference Books

1. S. D. Conte and Carl de Boor, Elementary Numerical Analysis- An Algorithmic Approach,3/e, McGraw Hill, New York, 1980.
2. B. S. Grewal, Numerical Methods for Engineers and Scientist, Khanna Publications, 2010.
3. Bhattacharya, Jain and Nagpaul, First Course in linear algebra, Wiley Eastern, 1991.
4. Lipschutz and Symour, 3000 Solved Problems Linear Algebra, TMH, 2004.

BM - 302 BIOMATERIALS **3-1-0 = 4**

Subject Code: *BM - 302.*
Subject Name: *Biomaterial*
No. of Hours Per Week: *Lectures-3, Tutorial-1.*
Marks Distribution: *Sessional Work = 60, End Semester Examination =90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any five.*
Duration of End Semester Examination: *Three Hours.*

UNIT I

Introduction: Definition of biomaterials, requirements of biomaterials, classification of biomaterials, Comparison of properties of some common biomaterials. Effects of physiological fluid on the properties of biomaterials. Biological responses (extra and intra-vascular system). Surface properties of materials, physical properties of materials, mechanical properties.

UNIT II

Metallic implant materials: Stainless steel, Co-based alloys, Ti and Ti-based alloys. Importance of stress-corrosion cracking. Host tissue reaction with biometal, corrosion behavior and the importance of passive films for tissue adhesion. Hard tissue replacement implant: Orthopaedic implants, Dental implants. Soft tissue replacement implants: Percutaneous and skin implants, Vascular implants, Polymeric implant materials,Polyolefins, polyamides, acrylic polymers, fluorocarbon polymers, silicon rubbers, acetals. (Classification according to thermosets, thermoplastics and elastomers). Viscoelastic behaviour: creep-recovery, stress-relaxation, strain rate sensitivity. Importance of molecular structure, hydrophilic and hydrophobic surface properties, migration of additives (processing aids), aging and environmental stress cracking. Physiochemical characteristics of biopolymers. Biodegradable polymers for medical purposes, Biopolymers in controlled release systems. Synthetic polymeric membranes and their biological applications.

UNIT III

Ceramic and Composite implant materials: Definition of bio ceramics. Common types of bio ceramics: Aluminium oxides, Glass ceramics, Carbons. Bioresorbable and bioactive ceramics. Importance of wear resistance and low fracture toughness. Host tissue reactions: importance of interfacial tissue reaction (e.g. ceramic/bone tissue reaction).Mechanics of improvement of properties by incorporating different elements. Composite theory of fiber reinforcement (short and long fibers, fibers pull out). Polymers filled with oestrogenic fillers (e.g. hydroxyapatite). Host tissue reactions.

UNIT IV

Biocompatibility & toxicological screening of biomaterials as well as Testing of biomaterials/Implants: Definition of biocompatibility, blood compatibility and tissue compatibility. Toxicity tests: acute and chronic toxicity studies (in situ implantation, tissue culture, haemolysis, thrombogenic potential test, systemic toxicity, intracutaneous irritation test), sensitization, carcinogenicity, mutagenicity and special tests. ETO, gamma radiation, autoclaving. Effects of sterilization on material properties. In vitro testing (Mechanical testing): tensile, compression, wears, fatigue, corrosion studies and fracture toughness. In-vivo testing (animals): biological performance of implants. Ex-vivo testing: in vitro testing simulating the in vivo conditions. Standards of implant materials.

Text Books

1. Buddy D**.** Ratner, Biomaterials Science**:** An Introduction to Materials in Medicine**,** Academic Press**,** San Diego**,** 1996**.**
2. Sujata V. Bhat, Biomaterials, Narosa Publishing House, 2002.
3. J. B. Park, Biomaterials - Science and Engineering, Plenum Press, 1984.
4. Burdick, Biomaterial for Tissue Engineering Applications, Panima, 2012.
5. A. Kulshrestha, Biomaterials, Panima, 2011.

Reference Books

1. Ratner, Biomaterials Science: An Introduction to Materials in Medicine 3rd Ed.Panima, 2011.
2. S. Ramakrishna, Biomaterials : A Nano Approach, Panima, 2011.
3. A. Chio, Biomaterials for MEMS, Panima, 2011.

EC – 303 SIGNALS AND SYSTEMS **3-1-0 = 4**

Subject Code: *EC- 303.*
Subject Name: *Signals and Systems.*
No. of Hours Per Week: *Lectures-3, Tutorial-1.*
Marks Distribution: *Sessional Work =60, End Semester Examination = 90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any Five.*
Duration of End Semester Examination: *Three Hours.*

UNIT– I

Introduction: signals and systems, examples of signals and systems; signal types: energy and power signals, continuous and discrete time signals, analog and digital signals, deterministic and random signals; signal properties: Symmetry, periodicity, and absolute integrability. Systems and system properties: linearity, shift-invariance, causality, stability, realizability. Continuous time and discrete time linear shift-invariant (LSI) systems: the impulse response and step response; response to arbitrary inputs: convolution, interconnections; characterization of causality and stability of linear shift-invariant systems.

UNIT– II

Signal representation: signal space and orthogonal bases of signals, Fourier series representation; Fourier Transform and properties, Parseval's Theorem, time-bandwidth product; Phase and group delays; Hilbert transform, pre- envelope. Spectral Analysis: Energy, power, Parseval's theorem, Energy, Power Spectral density functions (PSDF), the autocorrelation function, Cross correlation function, relationship between PSD function and auto correlation function.

UNIT– III

Complex Frequency, Laplace Transforms, shifting theorems, initial value theorem, final value theorem, effects of differentiation and integration in time domain. System transfer function, poles and zeroes, impulse response convolution, transient and steady state analysis (R-L-C circuit), solution of linear differential equations.

UNIT– IV

Discrete signals, z-transform and Inverse z-transforms, relation between s–plane and z–plane. Shifting theorem, Initial value theorem and final value theorem, transfer function of delay unit, realization of z-domain transfer function, unit sample response convolution. Solution of difference equations.

Text Books

1. A.V.Opponheim, A.S.Willsky and Nawab, Signals and Systems, 2/e, PHI, 2006.
2. R. A. Grabel and R. A. Roberts, Signals and Linear System, John Willey and Sons, 1987.
3. V. Krishnaveni, A. Rajeswari Signal and Systems, Wiley, 2012.
4. K.M. Soni, Signal and System, S. K kataria and Sons, 2010.

Reference Books

1. R.F. Ziemer, W. H. Tranter, Signals and Systems – Continuous and Discrete, 4/e, PHI, 2005.
2. I. J. Nagrath, S.N. Saran, R.Ranjan and S. Kumar, Signals and Systems, TMH, 2001.
3. Roberts, Signal and Systems: Analysis using Transformed Method and MATLAB, TMH, 2003.
4. Ronald Bracewell, The Fourier Transform and its Applications, 3/e, TMH, 2003.

BM-304 HUMAN ANATOMY & PHYSIOLOGY-I **3-1-0 = 4**

Subject Code: *BM - 304.*
Subject Name: *Human Anatomy & Physiology-I*
No. of Hours Per Week: *Lectures-3, Tutorial-1.*
Marks Distribution: *Sessional Work = 60, End Semester Examination =90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any five.*
Duration of End Semester Examination: *Three Hours.*

UNIT I

Structure and function of cell & cellular components – membrane Potential – action Potential – generation and conduction. Blood Cell – Composition – Fluid and electrolytic balance - Blood Groups – Estimation of RBC, WBC and platelet.

UNIT II

Genetic control of protein synthesis, cell function and cell reproduction. Basic tissues & functions in brief. Overview of Immune system – Immune response – models of immune response – Autoimmune diseases

UNIT III

Outline of structures of the following systems: - Cardiovascular system, Respiratory system, Alimentary system, Central Nervous system

UNIT IV

Outline of structures of the following systems:- Reproductive system, Urinary system, Muscular System, Endocrine system. Sense organs: Eye, Ear, Integumentry system (skin study)

Text Books

1. Ross and Wilson, Anatomy and physiology in health and illness, ELBS pub, 2010
2. A. Vander, J. Sherman and D. Luciante, Human Physiology by, ELBS Pub,2010
3. Charles E Tobin Basic Human theory, McGraw Hill, 2010
4. A. Vander, J. Sherman and D. Luciano Human Physiology, McGraw Hill, 2011
5. Charles E Tobin, Basic Human Theory, McGraw Hill, 2011

Reference Books

1. Charles E Tobin , Manual of Human Dissection, McGraw Hill, Edition 4, 1961.
2. J Gibson, Modern Physiology and Anatomy of Nurses, Black Well, 1981.
3. Guyton, Physiology of human body, Prism books, 2010.
4. Tortora and Grabowski, Principles of anatomy and physiology, hapercollin pub. 2007.

IT – 305 DATA STRUCTURES AND ALGORITHMS **3-1-0 = 4**

***Subject Code**: IT - 305.*
***Subject Name**: Data Structures and Algorithms.*
***No. of Hours Per Week**: Lectures-3, Tutorial-1.*
***Marks Distribution**: Sessional Work = 60, End Semester Examination = 90.*
***Questions to be set:** Eight (one from each unit and remaining three from the combination of more than one unit).*
***Questions to be answered:** Any Five.*
***Duration of End Semester Examination:** Three Hours.*

UNIT - I

Introduction to Data structure, Time and Space analysis of Algorithms, Order Notations, *Linear Data Structures***:** *List:* array and link list representation, insertion, deletion and searching elements in a list, traversing a list, Sparse matrices, doubly link lists- traversing, inserting, deleting, searching in a doubly link list, *Stack:*- Array and Link list representation, operations on stacks, its application in prefix, postfix and infix expression, *Queue***:** array and link list representation, insertion and deletion operations on queues, Dequeues, and Circularqueue implementation and operations associated.

UNIT - II

*Non-linear Data Structure***:** Introduction to Tree, Representation of Tree, Binary Trees, Tree traversals, Introduction and representation of binary search tree.

UNIT - III

*Binary Search Tree***:** Searching, insertion and deletion operation in a Binary Search Tree.
*AVL tree***:** representation, searching, inserting and deleting in AVL tree, B-trees representation, searching, insertion and deletion in a B Tree

UNIT - IV

*Graphs, Sorting and Searching Algorithms***:** Introduction to graph theory, array and link list representations, Breadth-first and Depth-first Search. Minimum spanning tree algorithms- Kruskal's algorithms, shortest path algorithms, Warshall's algorithms. Bubble sort, Selection Sort, Insertion Sort, Quick sort, Merge Sort, Heap sort. Linear Search, Binary Search, *Hashing:* Hashing functions, searching using hash technique, Collision avoidance techniques- linear probing, separate chaining.

Text Books

1. Aho Alfred V. Hopperoft John E, UIlman Jeffrey D., Data Structures and Algorithms, Pearson, 2002.
2. S. Lipschutz, Data Structures, 4/e, TMH, 2006.
3. Horowitz Ellis and SartajSahni, Fundamentals of Data Structures, Galgotia Publ., YP, 2010.
4. Maria S. Rukadikar, Data Structure and Algorithm, Shroff, 2011.
5. Mark Allen Weiss, Data Structure and Algorithm Analysis in C, Pearson, 2007.

Reference Books

1. Y. Langsum, M. J. Augenstein, and A. M. Tenenbaum, Data Structures using C and C++, 2/e, PHI, YP. 2010.
2. M. Radhakrishnan and V. Srinivasan, Data Structure Using C, ISTE/EXCEL Books, YP. 2010.

BM- 314 HUMAN ANATOMY& PHYSIOLOGY LABORATORY-I **0-0-3 = 2**

Subject Code: *BM-314.*
Subject Name: *Human Anatomy & Physiology Laboratory-I.*
No. of Hours Per Week: *Practicals-3.*
Marks Distribution: *Sessional Work = 20, End Semester Examination = 30.*
Minimum number of Experiments to be carried out: *Eight.*
***Question to be answered*:** *One experiment will be allotted to a student on lottery basis.*
Duration of End Semester Examination: *Four Hours*

List of Experiments:-

1. To study the
a) T.S. of Pancreas Gland.
b) T.S. of Liver Gland.
c) T.S. of Thyroid Gland.
d) T.S. of Adrenal Gland.
e) T.S. of Spinal cord.

2. To study the effects of various trends of solution on RBCs.
3. To study the effect of acid and alkali on RBCs.
4. To study the effect of chloroform on RBCs.
5. To study estimation of erythrocyte sedimentation rate (ESR).
6. Estimation of haemoglobin percentage by haemometer.
7. To determine the total no. of RBCs in Human blood.
8. To determine the total no. of WBCs in Human blood.

Text Books

1. Ross and Wilson Anatomy and physiology in health and illness, ELBS pub, 2010
2. A.G. Guyton; Textbook of Medical Physiology; Saunders, Philadelphia, 1986
3. Tortora and Grabowski, Principles of Anatomy and Physiology, Haper Collin pub, 2010
4. Susan J. Mitchell and E. N. Marieb, Human Anatomy & Physiology Laboratory Manual, Benjamin-Cummings Publishing Company, 2010.

Reference Books

1. Charles E Tobin , Manual of Human Dissection, McGraw Hill, Edition 4, 1961
2. J Gibson, Modern Physiology and Anatomy of Nurses, Black Well, 1981.
3. Guyton, Physiology of human body, Prism books, 2010
4. Tortora and Grabowski, Principles of anatomy and physiology, hapercollin pub. 2007

IT – 315 DATA STRUCTURE LABORATORY **0-0-3 = 2**

Subject Code: *IT - 315.*
Subject Name: *Data Structure using C Laboratory.*
No. of Hours Per Week: *Practicals-3.*
Marks Distribution: *Sessional Work = 20, End Semester Examination = 30.*
Question to be set**:** *All Questions.*
Question to be answered**:** *One will be allotted to a student on lottery basis.*
Duration of End Semester Examination: *Four Hours.*

List of Programs

1. Array implementation of Stacks, Queue, and Circular queue and dequeue datastructure.
2. Link List implementation of Stacks, Queue, Circular queue and dequeue data structures.
3. Implementation on conversion of infix expression to prefix and postfix using Stack,
4. Implementation on evaluation of expression using Stack.
5. Link list representation of binary tree and perform insertion, deletion operation on it.
6. Implementation of tree traversals techniques (in order, preorder and post ordertraversals).
7. Implementation of binary search tree and perform searching on it.
8. Implementation of Breath first search in a graph.
9. Implementation of Depth first search in a graph.
10. Implementation of Kruskal's algorithms.
11. Implementation of Warshall's algorithms.
12. Implementation of Insertion sort techniques.
13. Implementation of Bubble sort techniques.
14. Implementation of Selection sort techniques.
15. Implementation of Heap sort techniques.
16. Implementation of Binary search techniques.
17. Implementation of Hashing using chaining and linear probing technique.

Text Books

1. Aho Alfred V., Hopperoft John E., UIlman Jeffrey D., Data Structures and Algorithms, Pearson, 2002.
2. S. Lipschutz, Data Structures, 4/e, TMH, 2006.
3. Horowitz Ellis and SartajSahni, Fundamentals of Data Structures, Galgotia Publ., YP, 2010.
4. Maria S. Rukadikar, Data Structure and Algorithm, Shroff, 2011
5. Mark Allen Weiss, Data Structure and Algorithm Analysis in C, Pearson, 2007.

Reference Books

1. Y. Langsum, M J Augenstein, and A M Tenenbaum, Data Structures using C and C++,2/e, PHI, YP. 2010
2. M. Radhakrishnan and V.Srinivasan, Data Structure Using C, ISTE/EXCEL Books, YP. 2010.

BM – 316 BIOMEDICAL SIGNALS AND SYSTEMS LABORATORY **0-0-3 = 2**

Subject Code: *BM - 316.*
Subject Name: *Biomedical signals and systems laboratory*
No. of Hours Per Week: *Practicals-3.*
Marks Distribution: *Sessional Work = 20, End Semester Examination = 30.*
Minimum number of Experiments to be carried out: *Eight.*
***Question to be answered*:** *One experiment will be allotted to a student on lottery basis.*
Duration of End Semester Examination: *Four Hours.*

List of Experiments:-

1. Analysis of ECG, EEG, and EMG signals.
2. To study important commands of MATLAB software
3. To develop elementary signal function modules (m-files) for unit sample, unit step, exponential and unit ramp sequences.
4. To develop program for discrete convolution and correlation.
5. To develop program for computing inverse Z-transform
6. To develop program for computing DFT and IDFT.
7. To develop program for computing circular convolution.
8. To develop program for computing circular convolution.
9. To develop program for designing IIR filter.
10. To develop a program ECG data compression.

Text Books

1. A. P. Malvino, Electronics Principles, 6/e, TMH, 2005.
2. R. L. Boylestead and L. Nashelsky, Electronic Devices and Circuit Theory, 9/e, PHI, 2006.

6. FORTH SEMESTER PAPERS

MA – 401 STATISTICS AND RANDOM PROCESSES **3-1-0 = 4**

Subject Code: *MA - 401.*
Subject Name: *Statistics and Random Processes.*
No. of Hours Per Week: *Lectures-3, Tutorial-1.*
Marks Distribution: *Sessional Work = 60, End Semester Examination = 90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any Five.*
Duration of End Semester Examination: *Three Hours.*

UNIT – I

Introduction to probability: Events, Set, set operations, sigma and Borel fields, classical and relative frequency based definitions of probability, axiomatic definition of probability, conditional probabilities, independence, total probability, Baye's rules and applications, Repeated trails. *Random variables*: Continuous and discrete random variables, cumulative distribution function (cdf), probability mass function (pmf), probability density functions (pdf) and properties. *Some special distributions*: Binomial and Poisson discrete distributions, Uniform, exponential, Gaussian and Raleigh continuous distributions.

UNIT – II

Two dimensional random variables: joint distribution and density functions, marginal probability distribution, conditional probability distribution, independence. Functions of random variable, functions of two random variables, n-varaite random variables. Expected value of a random variable(s), mean, variances and moments of random variables, Joint moments, conditional expectation, covariance and correlations, independence, uncorrelated and. Random vector: mean vector, covariance matrix and properties, Multivariate Gaussians distributions, vector- space representation of random variables, linear independence, inner product, Schwarz inequality.

UNIT – III

Sequence of random variables: almost sure and mean square convergence, convergence in probability and distribution, law of large numbers, central limit theorem. *Elements of estimation theory* orthogonal random variables - Linear minimum mean-square error and orthogonality principle in estimation, Bounds and approximations- Chebyshev's inequality and chernoff bounds. Hypothesis testing, Moment generating and characteristic functions and their applications.

UNIT – IV

Random Proccess: Discrete and continuous time processes, probabilistic description of random process, mean, auto correlation and auto covariance functions. ***Stationarity*:** strict sense stationary (SSS), wide sense stationary (WSS) processes, auto correlation functions of a WSS process and its properties, Cross correlation functions. Ergodicity, spectral representation of a real WSS process, Spectral factorization theorem. White noise process and white noise sequence. Gaussian process, Poison process and Markov processes.

Text Books

1. A, Papoulis and S.U. Pillai, Probability, Random Variables and Stochastic Process, 4/e, McGraw Hill, 2002.
2. H. Stark and J.W. Woods, Probability and Random Processes with Applications to SignalProcessing, Prentice Hall, 2002.

3. John W. Woods andHenry Stark, Probability Statics and Random process for Engineer, Prentice Hall, 2011
4. Robert Lipster, Robert Liptser, Albert N. Shiryaev, Statics of Random Process, Springer, 2000.

Reference Books

1. P. Z. Pebbles, Probability, Random Variables and Random Signals Principles, 4/e, McGraw Hill, 2000.
2. T. Veerarajan, Probability, Statistics and Random Processes, 2/e, McGraw Hill, 2003.

BM - 402 BIOMEDICAL INSTRUMENTATION-I **3-1-0 = 4**

Subject Code: *BM - 402.*
Subject Name: *Biomedical Instrumentation-I.*
No. of Hours Per Week: *Lectures-3, Tutorial-1.*
Marks Distribution: *Sessional Work = 60, End Semester Examination =90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any five.*
Duration of End Semester Examination: *Three Hours*

UNIT I

Bioelectric Amplifiers: Special features of bioelectric amplifiers, safety requirements, realization of bioelectric amplifiers, carrier amplifiers, chopper amplifiers, phase sensitive detector, isolation amplifiers, and instrumentation amplifiers.

UNIT II

Biomedical Transducers &Bio electrodes: Bio electrodes for ECG, EEG. EMG, study of ECG in detail as sample case, Recording of ECG, EMG & EEG signals. Holter monitor and cardiac stress test. Biomedical transducers-pressure, temperature, humidity and moisture, transducers for respiratory measurements, blood pressure measurements (Mercury and Aneroid Types) Skin resistance measurements.

UNIT III

Patient Monitoring System: Different component of patient monitoring system, sources of artifacts and their implication, organization and equipment's used in ICCU & ITU. Computer assisted patient monitoring system (bedside monitors, central monitors, measurement of heart rate, blood pressure, respiratory rate, impedance pneumography, apnea detectors, etc.).

UNIT IV

Analytical &Diagnostic Instruments: Common analytical equipment used in hospitals and those in Biochemistry laboratories, Blood Flow meters, Pulmonary function analyzers, Blood gas analyzers: Different types of Oximetry systems, Blood pressure and heart sound measurement, Heart sound measurement Blood cell counters.

Text Books

1. Carr & Brown, Introduction to Biomedical Equipment Technology, Pearson Education, Asia. 2010
2. J. Webster, Bioinstrumentation, Wiley & Sons. 2010
3. R. B. Northrop, Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation, CRC Press. 2010
4. Shakti Chatterjee and Aubert Miller, Biomedical Instrumentation, Cengage Engineering, 2011
5. K. N. Scott and A. K. Mathur, Text Book of Biomedical Instrumentation, CBS Publisher, 2007

Reference Books:

1. R. S. Khandpur, Handbook of Bio-Medical Instrumentation, Tata McGraw Hill. 2010
2. Joseph Bronzino, Biomedical Engineering and Instrumentation, PWS Engg . , Boston, 2010
3. Harry Bronzino E, Handbook of Biomedical Engineering and Measurements, Reston, Virginia. 2010

BM – 403 BIOMECHANICS **3-1-0 = 4**

Subject Code: *BM - 403.*
Subject Name: *Biomechanics*
No. of Hours Per Week: *Lectures-3, Tutorial-1.*
Marks Distribution: *Sessional Work = 60, End Semester Examination =90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any five.*
Duration of End Semester Examination: *Three Hours*

UNIT I

Introduction to biomechanics**,** kinesiology, basic mechanical concepts**,** types of motion**,** movement terms. Basic kinematics concepts**,** vectors & trigonometry, Position of anatomical axis & corresponding movements of the body part.

UNIT II

Tissue Biomechanics: Solids and Structures: Biological Materials Properties, Viscoelasticity, Simple Structure, Hydrostatic Structure, Structural Systems, Biomechanical characteristic of bone & the soft tissue structure: tendons, ligaments, muscles, function & physiological factors.

UNIT III

Movement Biomechanics: Gait analysis, body & limbs: mass & motion characteristics actions, forces transmitted by joints. Joints forces results in the normal & disable human body, normal & fast gait on the level. Patterns: Push/Throw Continuum Biomechanics of push - like motions, Biomechanics of throw - like motions.

UNIT IV

Prosthetics & Orthotics: Principles in designing orthosis& prosthesis: Principles of three-point pressure, total constant and partial weight releaving, Design Considerations. Purpose for providing prostheses &orthosis: Various aspects regarding diagnosis, prognosis, stature & socio-economic condition. Classification in prosthetics & orthosis: Lower Extremity orthosis & prostheses, Upper Extremity orthosis & prosthesis, Spinal orthosis, Recent developments in prosthetics & orthosis.

Text Books

1. R. M. Kennedy, A textbook of Biomedical Engineering, GTU, 2010
2. Richard Shalak&ShuChien, Handbook of Bioengineering,
3. Sean P. Flanagan, Flanagan, Biomechanics: A case based Approach, Jones & Bartlett Publishers, 2013
4. Y. C. Fung, Yuan-Cheng Fung,Biomechanics: mechanical Proparty of living Tissue, Springer, 1996.
5. Carol A. Oatis, The Mechanics and Pathomechanics of Human Movement, Lippincott Williams & Wilkins, 2010
6. Sean P. Flanagan, Flanagan, Biomechanics: A Case Based Approach, Jones & Bartlett Publishers, 2013.

Reference Books

1. Prof. Ghista,Biomechanics, Private Publication UAF, 2009
2. White &Puyator, Biomechanics, Private publication UAE, 2010

BM- 404 MEDICAL BIOCHEMISTRY **3-1-0 = 4**

Subject Code: *BM - 404.*
Subject Name: *Medical Biochemistry*
No. of Hours Per Week: *Lectures-3, Tutorial-1.*
Marks Distribution: *Sessional Work = 60, End Semester Examination =90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any five.*
Duration of End Semester Examination: *Three Hours*

UNIT I

Introduction to Biochemistry and Medicine: Cell, Eukaryotic cell structure, functional role of each Organelle, Sub cellular Fractionation: Differential Centrifugation, Redox potentials & Oxidative phosphorylation, Transport of substances across biological membrane function. Enzymes (Proteins): Chemical nature of enzymes (Proteins). General properties of enzymes, Spectrophotometric measurement of enzymes (proteins) isolation methods study of enzyme properties, Diagnostic enzymes.

UNIT II

Nucleic Acids: Composition and functions of nucleic acids (A brief account) Genes, Outlines of DNA structure, Recombinant DNA and its applications. Urine chemistry: Chemical composition of urine under normal and abnormal conditions.

UNIT III

Instrumentation: Principles and applications of photometry, spectrophotometry fluorometry, nephalometry and turbidimetry, Biochemical analysis carried out in the estimation of blood constituents like glucose, urea, creatinine, protein, cholesterol, bilirubin etc., Separation of Serum Proteins by electrophoresis, Automation in biochemical analysis.

UNIT IV

Acid base homeostasis : Acids, bases, measurement of pH and glass electrodes, Role of kidney and lungs in acid base balance, Biochemical measurement of acid base status of patients, Blood gas analyzer disorders of acid-base balances. Isotopes: Definitions, Units, radioactive isotopes, Applications of isotopes in life sciences and medicine.

Texts Books

1. Jagmohan, Organic Spectroscopy-Principles and applications, Narosa Publish House, 2009
2. A.V.S.S. Rama Rao, A textbook of biochemistry, UBSPD, 2008
3. N. Hooper, Instant Notes on Biochemistry, Taylor & Francis Group, 2011
4. T. Palmer and P. Bonner, Enzymes-Biochemistry, Biotechnology, Clinical chemistry, Affiliated East-West Press Pvt. Ltd (AEWP), 2008
5. Duane C Eichler, Medical Biochemistry: Pearl of wisdom, Jones & Bartlett Publishers, 2006.

Reference Books

1. Jag Mohan, Organic Analytical chemistry-Theory and practice by. Narosa publishing, 2010.
2. Harper's, Biochemistry, 25th edition, McGraw Hill, 2010
3. J.L. Jain, Sanjay Jain, Fundamentals of biochemistry, S. Chand, 2010

BM – 405 HUMAN ANATOMY & PHYSIOLOGY-II **3-1-0 = 4**

Subject Code: *BM - 405.*
Subject Name: *Human Anatomy & Physiology-II.*
No. of Hours Per Week: *Lectures-3, Tutorial-1.*
Marks Distribution: *Sessional Work = 60, End Semester Examination = 90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any five.*
Duration of End Semester Examination: *Three Hours.*

UNIT I

Cardiovascular system: Heart, conductive tissue of heart, cardiac cycle, heart valves, systemic & pulmonary circulation, Transmission of cardiac impulse, blood pressure. **Respiratory system:** respiration external (ventilation), Exchange in gases in the alveoli, Artificial respiration.

UNIT II

Excretory system: Structure of Nephron, formation of urine & function of kidneys, urinary bladder, urethra, internal/external sphincters. **Nervous system:** different parts, their functions, Reflex action & reflex arc. Function of sympathetic nervous system. Nervous conduction & action potentials,

UNIT III

Alimentary system: all organs of the digestive system, other secretions & main functions, **Blood:** composition of blood-blood cells & their functions, haemoglobin.

UNIT IV

Reproductive system: (male & female), **Endocrine system:** All glands, their secretions. Control of secretions, Muscle physiology, Physiological aspects of skin resistance.

Text Books

1. Ross and Wilson, Anatomy and physiology in health and illness, ELBS pub, 2010
2. B. K. Sheshadri, Human Anatomy and Physiology in Pharmacy, Sonali Publication, 2007.
3. Charles E Tobin, Basic Human theory, McGraw Hill, 2008.
4. A. Vander, J. Sherman and D. Luciano, Human Physiology, McGraw Hill, 2010
5. Charles E Tobin, Basic Human Theory, McGraw Hill 2011

Reference Books

1. Charles E Tobin , Manual of Human Dissection, McGraw Hill, Edition 4, 1961
2. J. Gibson, Modern Physiology and Anatomy of Nurses, Black Well, 1981.
3. Guyton, Physiology of human body, Prism books, 2008
4. Tortora and Grabowski, Principles of anatomy and physiology, Haper Collin Pub, 2010

BM- 412 BIOMEDICAL INSTRUMENTATION LABORATORY -I **0-0-3 = 2**

Subject Code: *BM-412.*
Subject Name: *Biomedical Instrumentation Laboratory-I.*
No. of Hours Per Week: *Practicals-3.*
Marks Distribution: *Sessional Work = 20, End Semester Examination = 30.*
Minimum number of Experiments to be carried out: *Eight.*
***Question to be answered*:** *One experiment will be allotted to a student on lottery basis.*
Duration of End Semester Examination: *Four Hours*

List of experiments:-

1. Measurement of waveform, amplitude, durations and frequency using CRO, triggering of beam with an external signal.
2. Demonstration of optics of simple microscopes, illustrations and function.
3. Characterization of bio-potentials amplifier for ECG & EMG signals.
4. Study of EEG Signal, to measure the amplitude frequency & nature of EEG.
5. Indirect Method of Blood Pressure Measurement.
6. Measurement of heart sound using electronic stethoscope.
7. Measurement of Heart Rate using heart rate monitor.
8. Measurement of galvanic skin resistance.
9. ICU visit and study of different monitors.

Text Books

1. Carr & Brown, Introduction to Biomedical Equipment Technology, Pearson Education, Asia. 2008.
2. J. Webster, Bioinstrumentation, Wiley & Sons. 2010.
3. R.S Khandpur, Biomedical Instrumentation: Technology and Applications, Tata McGraw-Hill, 2006.
4. Hall T. Martin, Meg L. Martin, Lab view for Automotive: Biomedical and Other Application 3rd edition, Prentice Hall Ptr**,** 2000

Reference Books:

1. R. S. Khandpur, Handbook of Bio-Medical Instrumentation, Tata McGraw Hill. 2010
2. Joseph Bronzino, Biomedical Engineering and Instrumentation, PWS Engg. , Boston, 2010
3. Harry Bronzino E, Handbook of Biomedical Engineering and Measurements, Reston, Virginia. 2010
4. Leslie Cromwell, Biomedical Instrumentation and Measurements, Pearson Education. 2011
5. Geddes & Baker, Principles of Applied Biomedical Instrumentation, Wiley. 2011.

BM- 414 MEDICAL BIOCHEMISTRY LABORATORY **0-0-3 = 2**

Subject Code: *BM-414.*
Subject Name: *Medical Biochemistry Laboratory.*
No. of Hours Per Week: *Practicals-3.*
Marks Distribution: *Sessional Work = 20, End Semester Examination = 30.*
Minimum number of Experiments to be carried out: *Eight.*
***Question to be answered*:** *One experiment will be allotted to a student on lottery basis.*
Duration of End Semester Examination: *Four Hours*

List of Experiments:-

1. To perform estimation of blood glucose level by enzymatic method.
2. Proteins: Test for Albumin and globulin, Test for Cysteine.
3. Estimation of Blood Urea.
4. Estimation of Blood Cholesterol.
5. To perform Liver function test (SGOT).
6. To perform Liver function test (SGPT).
7. To perform Alkaline phosphates test.
8. To Study of abnormal urine content bile pigment salt.
9. Estimation of total serum bilirubin.
10. Estimation of gastric juices – pH and acidity test.

Text Books

1. Jag Mohan, Organic Spectroscopy-Principles and applications, Narosa Publish House, 2009
2. A. V. S. S. Rama Rao, A textbook of biochemistry, UBSPD, 2008
3. N. Hooper, Instant Notes on Biochemistry, Taylor & Francis Group, 2011
4. T. Palmer and P. Bonner, Enzymes-Biochemistry, Biotechnology, Clinical chemistry, Affiliated East-West Press Pvt. Ltd (AEWP), 2008
5. Duane C. Eichler, Medical Biochemistry: Pearl of wisdom, Jones & Bartlett Publishers, 2006.

Reference Books

1. Jag Mohan, Organic Analytical chemistry-Theory and practice by. Narosa publishing, 2010.
2. Harper's, Biochemistry, 25th edition, McGraw Hill, 2010
3. J.L. Jain, Sanjay Jain, Fundamentals of biochemistry, S. Chand, 2010

BM – 415 HUMAN ANATOMY & PHYSIOLOGY LABORATORY-II **0-0-3 = 2**

Subject Code: *BM - 415.*
Subject Name: *Human Anatomy & Physiology Laboratory-II*
No. of Hours Per Week: *Practicals-3.*
Marks Distribution: *Sessional Work = 20, End Semester Examination = 30.*
Minimum number of Experiments to be carried out: *Eight.*
Question to be answered**:** *One experiment will be allotted to a student on lottery basis.*
Duration of End Semester Examination: *Four Hours.*

List of Experiments:-

1. To prepare the blood film of your own blood. Stain it and study the blood picture and Identify the various blood cells.
2. To determine your own blood group.
1. To determine the bleeding and clotting time of blood.
2. To study models of sensory organs available in the laboratory.
3. To perform the ECG wave identification.
4. Identification of fixed histological slides – nerve tissues (cerebellum, cerebral cortex, neurons,
5. Identification of fixed histological slides nodes of Ranvier, corneal cell space), renal tissues, blood vessels (artery & vein), skin, tongue, liver.
6. To determine the blood pressure of subject.
7. To determine the oxygen saturation level in the blood with Pulse Oxymeter.

Text Books

1. Ross and Wilson, Anatomy and physiology in health and illness, ELBS pub, 2010
2. B. K. Sheshadri, Human Anatomy and Physiology in Pharmacy, Sonali Publication, 2007.
3. Charles E Tobin, Basic Human theory, McGraw Hill, 2008.
4. A. Vander, J. Sherman and D. Luciano, Human Physiology, McGraw Hill, 2010
5. Charles E Tobin, Basic Human Theory, McGraw Hill 2011

Reference Books

1. Charles E Tobin , Manual of Human Dissection, McGraw Hill, Edition 4, 1961
2. J Gibson, Modern Physiology and Anatomy of Nurses, Black Well, 1981.
3. Guyton, Physiology of human body, Prism books, 2008
4. Tortora and Grabowski, Principles of anatomy and physiology, Haper Collin Pub, 2010

7. FIFTH SEMESTER PAPERS

BM – 501 BIO-TRANSPORT PROCESS **3-1-0 = 4**

***Subject Code: BM** - 501.*
***Subject Name:** Bio-Transport Process*
***No. of Hours Per Week:** Lectures-3, Tutorial-1*
***Marks Distribution:** Sessional Work = 60, End Semester Examination = 90.*
***Questions to be set:** Eight (one from each unit and remaining four from the combination of more than one unit).*
***Questions to be answered:** Any five.*
***Duration of End Semester Examination:** Three Hours.*

UNIT I

Introduction to fluid mechanics, heat and mass transfer. physical, chemical and rheological properties of blood. Unified approach of momentum, heat and mass transfer. Heat Transport: heat production in humans, Loss of heat to the environment, Heat transfer within the body.

UNIT II

Transport through cell membranes: Membrane structure, composition and permeability, Osmosis, Passive diffusion, Pressure diffusion, Facilitated transport, Facilitated diffusion of oxygen in haemoglobin solutions, Active transport, Pinocytosis.

UNIT III

Compartment modelling: Pharmacokinetic models, one-compartment and two compartment open models. Structure and gross operational features of the respiratory system, Gas transport mechanisms in the lungs, Oxygen and carbon dioxide transfer in the blood, Modelling oxygen uptake in the pulmonary capillaries.

UNIT IV

Structure and general features of operation of kidneys, Transport mechanisms in the tubules, Pore models of the glomerular tuft, Counter current mechanism of urine formation, Models of nephron function, Analytical model for Henle's loop. Artificial kidney devices: Haemodialysis, types of haemodialyzer.

Text Books

1. David O. Cooney, An introduction to fluid, heat & mass transport process- Principles, Vol.1, Marcel Dekker Inc., New York, 1976.
2. Edwin N. Lightfoot, Transport phenomena and living systems – Biomedical Aspects of Momentum and Mass Transport, John Wiley, 1974
3. R. Fournier, Basic, Transport Phenomena in Biomedical Engineering, Taylor& Francis; 2nd Edition, 2006
4. A. T Johnson, Biological Process Engg. An analogical approach to fluid flow, heat transfer, and mass transfer applied to biological system, John Wiley and Sons, 1999.

Reference Book

1. Ronald L. Fournier, Basic transport phenomena in biomedical engineering, Taylor Francis, 1998.
2. A. B. Ritter, S. Reisman, B. B. Michniak, Biomedical Engineering Principles, CRC Press, 2005
3. D. O. Cooney, Biomedical Engineering Principles- An introduction to fluid, heat and mass transfer processes, Marcel Dekker Inc. 1976.

EC – 502 MICROPROCESSOR **3-1-0 = 4**

Subject Code: *EC-502*
Subject Name: *Microprocessor*
No. of Hours Per Week: *Lectures-3, Tutorial-1.*
Marks Distribution: *Sessional Work = 60, End Semester Examination =90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any five.*
Duration of End Semester Examination: *Three Hours*

UNITI

8085 Programming. Stacks and subroutines, counters, time delays, Interrupts, Instruction cycle, machine cycle, timing diagrams. Memory Interfacing with 8085, Interfacing I/O, memory mapped I/O and I/O mapped I/O. Interfacing A/D and D/A converters. Stepper motor interface with 8085.

UNIT II

8155-Programmable I/O; 8255-Programmable Peripheral Interface; 8355-ROM; 8253 – Timer; 8251 – USART; 8257 – DMAC, 8259 – PIC.

UNIT III

8086/8088 architecture, instruction sets, addressing mode. Assembler directives and Advanced programming. Min and Max mode of operation.

UNIT IV

8086 Programming, Interrupts and DOS interrupt 21H functions. Interfacing A/D converters, data acquisition. Interfacing D/A converters, wave form generation.

Text Books

1. Ramesh S. Gaonkar, Microprocessor architecture, programming and applications with 8085, 5/e, Penram International Publishing (India) Pvt. Ltd., 2002.
2. B. Ram, Fundamentals of microprocessors and microcomputers, 3/e, DhanpatRai Publication, 1989.
3. Douglas V.Hall, Microprocessor and interfacing, McGraw Hill International Ed.,2/e, 2006.
4. Ajay Wadhwa, Microprocessor: 8085 Architecture, Programming and Interfacing, PHI Learning Pvt. 2010.

Reference Books

1. Rajasree, Advanced Microprocessors, 2/e, New Age Publishers, 2005.
2. Intel Corp., The 8080/8085 Microprocessor Book: Intel marketing communications, Wiley Inter science publications, 1980.
3. Adam Osborne and O. Kane, An introduction to microcomputers, Vol. 2 – Some real microprocessors, Galgotia Book source, New Delhi, 1980.
4. Triebel and Singh, The 8088 and 8086 Microprocessors, 4/e, Pearson Education, 2003.

BM-503 BIOMEDICAL SIGNAL PROCESSING **3-1-0 = 4**

Subject Code: *BM - 503*
Subject Name: *Biomedical Signal Processing*
No. of Hours Per Week: *Lectures-3, Tutorial-1.*
Marks Distribution: *Sessional Work = 60, End Semester Examination =90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any five.*
Duration of End Semester Examination: *Three Hours*

UNIT I

Discrete – Time Signals and Systems: Sampling of Analogue signals, aliasing, standard discrete time signals, classification, discrete time system, Linear time invariant stable casual discrete time systems, classification methods ,linear and circular convolution, difference equation representation, DFS, DTFT, DFT, FFT computations using DIT and DIF algorithms.

UNIT II

Infinite Impulse Response Digital Filters: Review of design of analogue Butterworth and Chebyshev Filters, Frequency transformation in analogue domain, Design of IIR digital filters using impulse invariance technique, Design of digital filters using bilinear transform, pre warping, Frequency transformation in digital domain, Realization using direct, cascade and parallel forms

UNIT III

Finite Impulse Response Digital Filters: Symmetric and Ant symmetric FIR filters, Linear phase FIR filters , Design using Frequency sampling technique, Window design using Hamming, Hanning and Blackmann Windows, Concept of optimum equiripple approximation, Realization of FIR filters , Transversal, Linear phase and polyphase realization structures.

UNIT IV

Analysis of Bio –Signals And Special Topics in BSP: Removal of artifacts-ECG, Event detection, ECG,P wave, QRS Complex, T wave, correlation analysis of ECG signals, Averaging of signals, PCG,ECG and EMG. Heart rate variability analysis, analysis of PCG signals, Analysis of Time variant systems, fixed segmentation, STFT, ACF, SEM and GLR.

Text Books

1. John G. Proakis and Dimitris G. Manolakis, Digital Signal Processing, Algorithms and Applications, PHI of India Ltd., New Delhi, 3rd Edition, 2000.
2. Rangaraj M .Rangayyan, Biomedical signal processing: A Case Study. IEEE press 2002.
3. Oppenheim and R. W Schafer, Digital Signal Processing, Prentice Hall India, 2005
4. D.C.Reddy, Biomedical Signal Processing – Principles and Technique, Tata McGraw-Hill., 2005

References Book

1. Sanjit K. Mitra Digital Signal Processing, A Computer Based Approach, Tata McGraw-Hill, New Delhi, 1998.
2. A. Antoniou , Digital Signal Processing, McGraw Hill, 2005
3. Iefeachor, Digital Signal Processing, Prentice Hall, 2002
4. J. G. Prokis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithm and Applications, PHI/Pearson Education, 1996

BM-504 BIOMEDICAL INSTRUMENTATIONS-II **3-1-0 = 4**

Subject Code: *BM - 504*
Subject Name: *Biomedical Instrumentations-II*
No. of Hours Per Week: *Lectures-3, Tutorial-1.*
Marks Distribution: *Sessional Work = 60, End Semester Examination =90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any five.*
Duration of End Semester Examination: *Three Hours*

UNIT I

Cardiac Pacemakers & Defibrillators: Effects of electric field on cardiac muscles and laws of stimulation. External, internal and programmable pacemakers. Pulse generator- sensing, output and timing circuits. Power sources, electrodes and leads system, pacing system analyzers. Defibrillators- basic principle and comparison of output wave forms of different DC defibrillator, energy requirements, synchronous operation, implantable defibrillators, defibrillator safety and analyzers, RF ablation treatment for arrhythmia.

UNIT-II

Ventilators and Anesthesia System: Basic principles of ventilators, different generators, inspiratory phase and expiratory phase, different ventilator adjuncts, neonatal ventilators, p based ventilator, ventilator testing. Anesthesia: Need of anesthesia, gas used and their sources, gas blending and vaporizers, anesthesia delivery system, breathing circuits.

UNIT-III

Physiotherapy Equipment's: Electrical stimulators: Strength-duration curve, types of stimulators, an electrodiagnostic / therapeutic stimulator. Nerve-muscle stimulator: peripheral nerve stimulator, Ultrasonic stimulators, stimulators for pain and relief.
Diathermy: IR diathermy, UV diathermy, short wave diathermy, microwave diathermy, ultrasonic diathermy, Surgical Diathermy.

UNIT-IV

Physics and engineering of ultrasonic lithotripter, basic principle of extracorporeal shock wave lithotripter. Principle operation of LASER, various application of CO2, argon, He -Ne, Nd – YAG & pulsed ruby LASER, Application of LASER in surgery. Electro surgery safety, testing electro surgery units, light sources, suction apparatus, LINAC and infusion pump. Baby incubator, radiant warmer and phototherapy unit.

Text Books

1. Carr & Brown, Introduction to Biomedical Equipment Technology, Pearson Education, Asia. 2010
2. J. Webster, Bioinstrumentation, Wiley & Sons. 2010
3. R. B. Northrop, Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation, CRC Press. 2010
4. Shakti Chatterjee and Aubert Miller, Biomedical Instrumentation, Cengage Engineering, 2011
5. K. N. Scott and A. K. Mathur, Text Book of Biomedical Instrumentation, CBS Publisher, 2007

Reference Books:

1. R. S. Khandpur, Handbook of Bio-Medical Instrumentation, Tata McGraw Hill. 2010
2. Joseph Bronzino, Biomedical Engineering and Instrumentation, PWS Engg . , Boston, 2010
3. Harry Bronzino E, Handbook of Biomedical Engineering and Measurements, Reston, Virginia. 2010
4. Leslie Cromwell, Biomedical Instrumentation and Measurements, Pearson Education. 2011
5. Geddes & Baker ,Principles of Applied Biomedical Instrumentation, Wiley. 2011

BM – 505 TISSUE ENGINEERING **3-1-0 = 4**

***Subject Code: BM** - 505.*
***Subject Name:** Tissue Engineering*
***No. of Hours Per Week:** Lectures-3, Tutorial-1*
***Marks Distribution:** Sessional Work = 60, End Semester Examination = 90.*
***Questions to be set:** Eight (one from each unit and remaining four from the combination of more than one unit).*
***Questions to be answered:** Any five.*
***Duration of End Semester Examination:** Three Hours.*

UNIT I

Introduction: Basic definition, Structural and organization of tissues: Epithelial, connective; vascularity and angiogenesis, basic wound healing, cell migration, current scope of development and use in therapeutic and in-vitro testing.

UNIT II

Cell culture: Different cell types, progenitor cells and cell differentiations, different kind of matrix, cell-cell interaction. Aspect of cell culture: cell expansion, cell transfer, cell storage and cell characterization, Bioreactors.

UNIT III

Molecular biology aspects: Cell signalling molecules, growth factors, hormone and growth factor signalling, growth factor delivery in tissue engineering, cell attachment: differential cell adhesion, receptor-ligand binding, and Cell surface markers.

UNIT IV

Scaffold and transplant: Engineering biomaterials for tissue engineering, Degradable materials (collagen, silk and polylactic acid), porosity, mechanical strength, 3-D architecture and cell incorporation. Engineering tissues for replacing bone, cartilage, tendons, ligaments, skin and liver. Basic transplant, immunology, stems cells: introduction, hepatopoiesis.

Text Book

1. Clemens van Blitterswijk, Tissue Engineering, Academic Press, 2008.
2. B. Palsson, S. Bhatia ,Tissue Engineering, Pearson Prentice Hall, 2003
3. G. Vunjak-Novakovic, R. Ian Freshney, Culture of Cells for Tissue Engineering, WIS, 2006.
4. J. D. Bronzino, The Biomedical Engineering –Handbook, CRC; 3rd edition , 2006
5. R. P. Lanza, R. Langer and W. L. Chick, Principles of tissue engineering, Academic press, 1997.

Reference Books

1. Robert. P.Lanza, Robert Langer & William L. Chick,Principles of tissue engineering, Academic press. 2007
2. B. Palsson, J.A. Hubbell, R.Plonsey& J.D. Bronzino, Tissue Engineering, CRC- Taylor &Francis. 2008

EC- 512 MICROPROCESSOR LABORATORY **0-0-3 = 2**

Subject Code: *EC-512*
Subject Name: *Microprocessor Laboratory*
No. of Hours Per Week: *Practicals-3.*
Marks Distribution: *Sessional Work = 20, End Semester Examination = 30.*
Minimum number of Experiments to be carried out: *Eight.*
***Question to be answered*:** *One experiment will be allotted to a student on lottery basis.*
Duration of End Semester Examination: *Four Hours*

List of Experiments:-

1. Write an 8085 ALP to perform Binary /BCD addition between two bytes stored in consecutive / different location (Generated Carry).
2. Write an 8085 ALP to perform Binary / BCD subtraction between two bytes stored in consecutive / different locations with sign of the result taken into account.
3. Write an 8085 ALP to generate of Fibonacci Series.
4. Write an 8085 ALP to reverse a string .The string is either a binary byte or a bunch of data bytes stored in consecutive locations.
5. Write an 8085 ALP to arrange the bytes (stored in consecutive locations) in sorted order either ascending or descending order.
6. Write an 8085 ALP to verify the incoming and outgoing data using LEDS and a PPI chip.
7. Write an 8085 ALP to generate a square wave of a certain frequency using PPI chip and a CRO display.
8. Write an 8086 ALP to find the largest number from an array of 16 bit numbers stored sequentially in memory location.
9. Write an 8086 ALP to convert a given word into its decimal equivalent.
10. Write an 8086 ALP to find out whether a given byte is present in the string or not.
11. Write a 8086 ALP program to open a new file kmb.dat in the current directory and drive if it is successfully opened. Write 200H Bytes of data into it from a data block named BLOCK. Display a message if the file is not opened successfully.
12. Write an ALP to interface a keyboard with 8086 microprocessor using PPI chips.
13. Write an ALP to interface a stepper motor with 8085 microprocessor using PPI chips.

Text Books

1. Ramesh S. Gaonkar, Microprocessor architecture, programming and applications with 8085, 5/e, Penram International Publishing (India) Pvt. Ltd., 2002.
2. B. Ram, Fundamentals of microprocessors and microcomputers, 3/e, DhanpatRai Publication, 1989.
3. Ajay Wadhwa, Microprocessor: 8085 Architecture, Programming and Interfacing, PHI Learning Pvt. 2010.
4. Barry B. Barry, The Intel Microprocessors: Archirecture, Programming and Interfacing 8th Edition, Pearson, 2008.

BM- 513 BIOMEDICAL SIGNAL PROCESSING LABORATORY **0-0-3 = 2**

Subject Code: *BM-513*
Subject Name: *Biomedical Signal Processing Laboratory*
No. of Hours Per Week: *Practicals-3.*
Marks Distribution: *Sessional Work = 20, End Semester Examination = 30.*
Minimum number of Experiments to be carried out: *Eight.*
***Question to be answered*:** *One experiment will be allotted to a student on lottery basis.*
Duration of End Semester Examination: *Four Hours*

List of Experiments:-

1. Sine wave generation using C.
2. Designing an FIR filter using MATLAB and DSP Kit.
3. Designing an IIR filter using MATLAB and DSP Kit.
4. Fourier analysis of periodic signal.
5. Time frequency domain properties of different windows using MATLAB.
6. Implementation of the Double-Precision Complex FFT for ECG signal.
7. Design of Notch filter for elimination of 50Hz from ECG signal.
8. EMG processing using MATLAB –Rectification and Signal Averaging.

Text Books

1. John G. Proakis and DimitrisG.Manolakis, Digital Signal Processing, Algorithms and Applications, PHI of India Ltd., New Delhi, 3rd Edition, 2000.
2. Rangaraj M. Rangayyan,Biomedical signal processing: A Case Study. IEEE press 2002.
3. Oppenheim and R. W Schafer, Digital Signal Processing, Prentice Hall India, 2005
4. D.C.Reddy, Biomedical Signal Processing – Principles and Technique, Tata McGraw-Hill., 2005

References Book

1. Sanjit K. Mitra 'Digital Signal Processing', A Computer Based Approach, Tata McGraw-Hill, New Delhi, 1998.
2. A. Antoniou , Digital Signal Processing, McGraw Hill, 2005
3. Iefeachor, Digital Signal Processing, Prentice Hall, 2002
4. J. G. Prokis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithm and Applications, PHI/Pearson Education, 1996

BM-514 BIOMEDICAL INSTRUMENTATION LABORATORY-II **0-0-3 = 2**

Subject Code: *BM-514*
Subject Name: *Biomedical Instrumentation Laboratory-II*
No. of Hours Per Week: *Practicals-3.*
Marks Distribution: *Sessional Work = 20, End Semester Examination = 30.*
Minimum number of Experiments to be carried out: *Eight.*
Question to be answered**:** *One experiment will be allotted to a student on lottery basis.*
Duration of End Semester Examination: *Four Hours*

List of Experiments:-

1. Power isolation: isolation transformer and DC-DC converters.
2. To study about operation of Pacemaker Circuits.
3. To study about operation of Defibrillators.
4. To study about operation of Holter monitor.
5. To study about operation of Ventilators.
6. To study about operation of Treadmill, ergometer.
7. Demonstration of operation and trouble shooting of Heart lung machine.
8. Audiometer.
9. Visit to Hospital/Medical Institute for Exposure**.**

Text Books

1. Carr & Brown, Introduction to Biomedical Equipment Technology, Pearson Education, Asia. 2010
2. J. Webster, Bioinstrumentation, Wiley & Sons. 2010
3. R. B. Northrop, Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation, CRC Press. 2010
4. Shakti Chatterjee and Aubert Miller, Biomedical Instrumentation, Cengage Engineering, 2011
5. K. N. Scott and A. K. Mathur, Text Book of Biomedical Instrumentation, CBS Publisher, 2007

Reference Books:

1. R. S. Khandpur, Handbook of Bio-Medical Instrumentation, Tata McGraw Hill. 2010
2. Joseph Bronzino, Biomedical Engineering and Instrumentation, PWS Engg . , Boston, 2010
3. Harry Bronzino E, Handbook of Biomedical Engineering and Measurements, Reston, Virginia. 2010
4. Leslie Cromwell, Biomedical Instrumentation and Measurements, Pearson Education. 2011
5. Geddes & Baker, Principles of Applied Biomedical Instrumentation, Wiley. 2011

8. SIXTH SEMESTER PAPERS

BM-601 MEDICAL IMAGING TECHNIQUES **3-1-0 = 4**

Subject Code: *BM - 601*
Subject Name: *Medical Imaging Techniques*
No. of Hours Per Week: *Lectures-3, Tutorial-1.*
Marks Distribution: *Sessional Work = 60, End Semester Examination =90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any five.*
Duration of End Semester Examination: *Three Hours*

UNIT I: X-Ray

Principles and production of soft X- rays and hard x rays**,** details of radiographic and fluoroscopic images in X-Ray systems. Screen-film and image intensifier systems-different generation of x-rays. X-Ray Detectors Solid State v/s Gas ionization detectors.Data Acquisition System. Image Processing & reconstruction Principles.

UNIT II: COMPUTED TOMOGRAPHY

Principles of CT, evolution of CT machines – CT image formation – Conversion of X-Ray data into scan image. Mathematical details of various algorithms. Spiral CT, Transverse Tomography, CT Angiography Generations of Scanners (Evolution, Data Acquisition Geometries).

UNIT III: MAGNETIC RESONANCE IMAGING

Principle of MRI/NMR concept of K Space & Fourier Transformation. Image acquisition in magnetic resonance imaging – T1, T2, proton density weighted images, spin-echo technique and spin relaxation technique. Artifacts in imaging. Various types of pulse sequences for fast acquisition of imaging. ECHO and fast imaging techniques. MR Angiography-Techniques and Principles Hardware a) Types of Magnets, Permanent and Electromagnet Resistive Magnet & Superconducting Magnet, b) Types of Coils, Gradient Coils, RF Coils, Shim Coils, Digital Data Processing- Block Diagram of MRI Scanner- Concept of Digital and analog domains of MRI

UNIT IV: ULTRASONICS& OTHER IMAGING TECHNIQUES

Medical imaging modalities – Ultrasonic –Physics of ultrasound – Principles of image formation – Capture and display, principles of A-Mode, B-Mode, M-Mode. scan converters, frame grabbers. Single line and multi-line monitoring of ultrasound displays. PET Scanner-Principles, SPECT, Computer techniques in fast acquisition – Data manipulation Principles of digital subtraction angiography. Infrared imaging,- Thermography, Clinical applications of thermography, liquid crystal thermography.

Text Books

1. Rafael C., Gonzalez and Richard E. Woods, Digital Image Processing, Pearson Education Asia, 2001
2. Anil K. Jain, Fundamentals of Digital Image Processing, Prentice Hall of India, 1997
3. Webb, S., The Physics of Medical Imaging, AdernHilger, Bristol & Philadelphia. 2010
4. R. C. Gonzalez, R. E. Woods, S. L. Eddins , Digital Image Processing Using MATLAB(R),Course Technology, 1 edition, 2004

Reference Books:

1. William K. Pratt, Digital Image Processing, John Wiley, NJ, 1987.
2. Albert Macouski, Medical Imaging systems, Prentice Hall, New Jersey.1983.

BM - 602 MODELLING OF PHYSIOLOGICAL SYSTEMS **3-1-0 = 4**

Subject Code: *BM - 602*
Subject Name: *Modelling of Physiological Systems*
No. of Hours Per Week: *Lectures-3, Tutorial-1.*
Marks Distribution: *Sessional Work = 60, End Semester Examination =90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any five.*
Duration of End Semester Examination: *Three Hours*

UNIT I

Approaches to Modelling: The technique of mathematical modelling, classification of models, characteristics of models, Purpose of physiological modelling and signal analysis, Linearization of nonlinear models, Time invariant and time varying systems for physiological modelling.

UNIT II

Equivalent Circuit Model: Electromotive, resistive and capacitive properties of cell membrane change in membrane potential with distance, voltage clamp experiment and Hodgkin and Huxley's model of action potential, the voltage dependent membrane constant and simulation of the model, model for strength-duration curve, model of the whole neuron.

UNIT III

Physiological Modelling: Electrical analog of blood vessels, model of systematic blood flow, model of coronary circulation, transfer of solutes between physiological compartments by fluid flow. Huxley model of isotonic muscle contraction, modelling of EMG, motor unit firing: amplitude measurement, motor unit & frequency analysis.

UNIT IV

Modelling for Immune and Urinary System: Counter current model of urine formation, model of Henle's loop, and Linearized model of the immune response: Germ, Plasma cell, Antibody, system equation and stability criteria.

Text books

1. Endarle, Blanchard &Bronzino, Introduction to Biomedical Engg. , Academic press. 2009
2. Suresh. R. Devasahayam, Signals & Systems in Biomedical Engineering, Kluwer Academic/ Plenum Publishers. 2010
3. V.Z. Marmarelis, Advanced methods of physiological modeling, Plenum Press. 2010.
4. Rolf Rannacher, Anne M. Robertson, Giovanni P. Galdi, Hydrodynamical flows: Modeling, Analysis and Simulation, springer, 2008.
5. V. Z. Marmarelis, Advance Methods of Physiological System Modelling, Plenum Publishers, 1994.

Reference books

1. J. Candy, Signal Processing: The Model Based approach, Mc. Graw Hill. 2010
2. L.Stark, Neurological Control System, Plenum Press. 2009
3. R.B. Stein, Nerve and Muscle, Plenum Press. 2009

BM-603 ARTIFICIAL ORGAN AND REHABILITATION ENGINEERING**3-1-0 = 4**

Subject Code: *BM - 603*
Subject Name: *Artificial Organ and Rehabilitation Engineering*
No. of Hours Per Week: *Lectures-3, Tutorial-1.*
Marks Distribution: *Sessional Work = 60, End Semester Examination =90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any five.*
Duration of End Semester Examination: *Three Hours*

UNIT I

Introduction to Artificial Organs: Biomaterials used in artificial organs and prostheses, inflammation, rejection, correction. Rheological properties of blood, blood viscosity variation: effect of shear rate, hematocrit, temperature and protein contents. Casson equation, flow properties of blood through the blood vessels, problems associated with extracorporeal blood flow.

UNIT II

Artificial Kidney and Artificial Heart-Lung Machine: Brief of kidney filtration, basic methods of artificial waste removal, hemodialysis, equation for artificial kidney and middle molecule hypothesis, Hemodialysers: flat plate type, coil type and hollow fiber, Analysis of mass transfer in dialyzers (cross current & concurrent flow), regeneration of dialysate, membrane configuration, wearable artificial kidney machine, separation of antigens from blood in ESRD patients. Brief of lungs gaseous exchange, artificial heart-lung devices. Oxygenators: bubble, film oxygenators and membrane oxygenators. Gas flow rate and area for membrane oxygenators. Liver support system, artificial pancreas, blood and skin.

UNIT III

Audiometry: air conduction, bone conduction, masking, functional diagram of an audiometer. Hearing aids: different types, receiver amplifiers. Opthalmoscope, retinoscope, I.A.B.P principle and application.

UNIT IV

Rehabilitation Engineering: Impairments, disabilities and handicaps, Measurement and assessment. Characterizing engineering concepts in sensory and motor rehabilitation. Engineering concept in communication disorders. Rehabs for locomotion, visual, speech & hearing. Artificial limb and hands, prosthetic heart valves. Externally powered and controlled orthotics and prosthetics. Myoelectric hand and arm prostheses. The marcus intelligent hand prostheses, gait study, spinal rehabilitation.

Text Books

1. D. O. Cooney, Biomedical Engineering Principles (Vol.-II)Marcel Dekker, Inc. 1976.
2. Robbinson C.J., Rehabilitation Engineering. CRC press 1995.
3. Hakim, S. Nadey. Artificial Organ, Springer, 2009.
4. L. Hench Biomaterials, Artificial Organs and Tissue Engineering, CRC Press, 2005

Reference Book

1. R. S. Khandpur, Handbook of Bio-Medical Instrumentation, Tata McGraw Hill. 2010
2. Joseph Bronzino, Biomedical Engineering and Instrumentation, PWS Engg . , Boston, 2010
3. Harry Bronzino E, Handbook of Biomedical Engineering and Measurements, Reston, Virginia. 2010

HU – 604 PROFESSIONAL ETHICS AND IPR **3-1-0 = 4**

Subject Code: *HU - 604.*
Subject Name: *Professional Ethics and IPR.*
No. of Hours Per Week: *Lectures-3, Tutorial-1.*
Marks Distribution: *Sessional Work = 60, End Semester Examination = 90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any Five.*
Duration of End Semester Examination: *Three Hours.*

UNIT – I

Engineering as a profession, historical and social context, Ethics in Engineering, Codes of Engineering Ethics, history and purpose, consequentialism and utilitarianism, Deontological approaches, duties, rights and respect for a person, responsibility, virtue Ethics, honesty, moral autonomy, obligations of Engineering profession and moral propriety.

UNIT-II

Engineer's moral responsibility for safety and human right, risk assessment and communication, product liability, development ethics, engineers and employer relationship, whistle blowing and its moral justifications. Computer Ethics: Social impact of computers, privacy, cybercrime, ethical use of software.

UNIT- III

IPR I: Intellectual property, definition, types, rights and functions, patents, trademark, software design, industrial designs, semi-conductor and integrated circuits layout design, grant of patent in India, authority and procedure, patent forms, surrender and revocation of Patents and compulsory licensing, acquisition of inventions by the Government.

UNIT- IV

IPR II: Contents of draft application for patents, Drafting patent specification and claims,WTO and drafting patent specification and claims, IPR infringement and piracy under IndianLaws.

Text Books

1. Vinod V. Sople, Managing Intellectual Property: The Strategic Imperative, PHI, 2006.
2. Charles and Harri Michael S Pritchard and Michael J Robins, Engineering Ethics, 2010
3. Concepts and cases, Wordsworth/ Thompson Learning, Belmont Calif, Case study of selected legal battles/cases on IPR and related issues, 2000
4. Dr. B. L. Wadehra, Law Relating to Intellectual Property, Universal Law Publishing, 2009.

Reference Books

1. Huff and Finholt, Social Issues in Computing: Putting Computing in Place, McGrawHill,1994.
2. Govindarajan, Natarajan and Senthil Kumar, Engineering Ethics, PHI, 2004.
3. Jones and Bartlett, Cyber Ethics: Morality and Law in Cyber Space, 4/e, Jones and Bartlett India Pvt. Ltd., 2011.
4. Schinzinger Roland Mike and Martin, Introduction to Engineering Ethics, Boston MA: TMH, 2000.
5. Robin Attfield, A theory of value and obligation, London, Croom Helm, 1987.

6. Elective-I

BM – 60511 BIOINFORMATICS **3-1-0 = 4**

Subject Code: *BM -6051.*
Subject Name: *Bioinformatics*
No. of Hours Per Week: *Lectures-3, Tutorial-1.*
Marks Distribution: *Sessional Work = 60, End Semester Examination = 90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any Five.*
Duration of End Semester Examination: *Three Hours.*

UNIT I

Introduction to genomics: Information flow in biology, DNA sequence data, experimental approach to genome sequence data, genome information resources.

UNIT II

Functional proteomics: Protein sequence and structural data, protein information resources and secondary data bases. Structural data bases: Small molecules data bases, protein information resources, PDB, genebank, Swissport, Enterz..

UNIT III

Computation genomics: Internet basics, biological data analysis and application, sequence and data bases, NCBI model, file format, Perl programming, bioperl, introduction and overview of human genomic project.

UNIT IV

Sequence alignment and data base search: Protein primary sequence analysis, DNA sequence analysis, pair wise sequence alignments, FASTA algorithm, BLAST, multiple sequence alignment, DATA base searching using BLAST and FASTA.

Text Books

1. Andrzej Polanski, Marek Kimmel, Bioinformatics, Springer publications, 2007
2. H. H. Rashidi and L. K. Buehler, Bioinformatics Basics. Applications in Biological Science and Medicine, CAC Press, 2000.
3. D. Gusfiled, Algorithms on Strings Trees and Sequences, Cambridge University Press, 1997.
4. D. Mount, Bioinformatics, CSH Publications, 2000.
5. Genomics and Proteomics-Functional and Computational aspects. Springer Publications, Editior-SandorSuhai, 2007

Reference Books

1. Atwood, Introduction to bioinformatics, Pearson education. 2009
2. Arther M. Lesk, Introduction to bioinformatics, OUP , 2010
3. David W. Mount, Bioinformatics sequences and genome analysis, 2nd. Edn. CBS publishers. 2010
4. Cynthia Gibas and Per Jambeck, Introduction to bioinformatics computer skills, SPD 2001.

Elective-I

BM – 60512 FUNDAMENTAL OF BIO-MEMS **3-1-0 = 4**

Subject Code: *BM -60512.*
Subject Name: *Biomedical Microsystems*
No. of Hours Per Week: *Lectures-3, Tutorial-1.*
Marks Distribution: *Sessional Work = 60, End Semester Examination = 90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any Five.*
Duration of End Semester Examination: *Three Hours.*

UNIT I

Introduction; photolithography; mask design; wet and dry etching; thin film deposition and growth, electroplating, moulding, LIGA, bonding and sacrificial processes, polymer processing and rapid prototyping.

UNIT II

Biomaterials and biocompatibility issues, micro total analysis system (μTAS): Fluid control components, μ-TAS: sample handling, μ-TAS: separation components, μ-TAS: detection.

UNIT III

Cell handling and characterization, systems for biotechnology and PCR, polynucleotide arrays and genetic screening.

UNIT IV

Miniature biosensors, biosensors arrays and implantable devices, neural interfaces, microsurgical tools, micro needles, and drug delivery, miniature bioreactors and Microsystems for tissue engineering, tissue scaffolds, optical biosensors, MEMS metrology, MEM Spackaging.

Text Book

1. Manz and H. Becker, Eds. Microsystem Technology in Chemistry and Life Sciences Spronger-Verlag, New York, 1999. ISBN: 3-540-65555-7
2. Steven S. Saliterman, Fundamental of Bio-MEMS and Medical Microdevice, springer, 2009.
3. A. P. Lee, Abraham P. Ed Lee, Bio-MEMS and Biomedical Nanotechnology, springer, 2006.
4. Handbook of Biosensors and Electronic Noses: Medicine, Food and the Environment, CRC-Press, 1 edition, 1996.
5. T. Togawa, T. Tamura and P. Ake Oberg, Biomedical Transducers and Instruments, CRC Press, 1997.

Reference Books

1) J. M. Pallis, Biomedical Engineering and Design Hand book, McGraw Hill, 2009
2) Steven S. Saliterman, Fundamental of Bio MEMS and Medical Microdevice, SPIE-International Society, 2006.
3) Kline Jacob,Handbook of Biomedical Engineering., Academic press (N.Y) 1988.
4) John D. Enderle, Susan M. Blanchard,Introduction to Bio-Medical Engineering, Elsevier, Academic Press, 2nd edition, 2005.
5) Dane E Karne & Michael C Raymer, Fundamental concepts of bioinformatics Pearsons Education, 2006.

Elective-I

BM – 60513 BIO-FLUID DYNAMICS **3-1-0 = 4**

Subject Code: *BM -6013.*
Subject Name: *Bio-Fluid Dynamics*
No. of Hours Per Week: *Lectures-3, Tutorial-1.*
Marks Distribution: *Sessional Work = 60, End Semester Examination = 90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any Five.*
Duration of End Semester Examination: *Three Hours.*

UNIT I

Fluids and non-fluids, continuum coordinate systems, force and moments, stress at a point, rate of strain, properties of fluids, classification of fluids.

UNIT II

Different type of fluid flows: laminar and turbulent flow, transition from laminar to turbulent flow, laminar flow-annulus, laminar flow between parallel plates and measurement of viscosity.

UNIT III

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

UNIT IV

Friction loss in flow in a tube, velocity distribution of aortic system, waveform of pressure and velocity in aorta, wave reflections and impedance in arterial segments, blood flow in veins and blood flow in capillaries. Control theory and system analysis, mechanical analysis of circulatory systems, basic concept of myocardial mechanics, index of contractibility, fluid dynamics of aortic and mitral valves.

Text Book

1. K. L. Kumar, Engineering fluid mechanics, Eurasia Publishing House (P) Ltd., New Delhi, 1998. (UNITS I, II & III).
2. D. H. Bergel, Cardiovascular fluid dynamics, Vol. I, Academic press, London & New York, 1972. (UNITS IV, V).
3. John Li, Dynamics of the Vascular System, World Scientific Publishing Co., 2009.

Reference Book

1. Lee Waite, Jerry Fine, Applied Biofluid Mechanics , Mac Grawhill publications, New Delhi 2007.

Elective-I

BM – 60514 NUCLEAR MEDICINE; RADIATION AND SAFETY **3-1-0 = 4**

***Subject Code: BM** – 60514.*
***Subject Name:** Nuclear Medicine; Radiation and Safety*
***No. of Hours Per Week:** Lectures-3, Tutorial-1*
***Marks Distribution:** Sessional Work = 60, End Semester Examination = 90.*
***Questions to be set:** Eight (one from each unit and remaining four from the combination of more than one unit).*
***Questions to be answered:** Any five.*
***Duration of End Semester Examination:** Three Hours.*

UNIT I

Introduction: Properties and effects of radioactive emissions and their applications in nuclear medicine. Radiation detectors: Types and applications in nuclear medicine.

UNIT II

Radio Isotope Imaging: The gamma camera, Construction and working, Performance Characteristics, SPECT Construction and Working, Positron Emission Tomography.

UNIT III

The computer in NM: Applications, Image Construction, Frame Modes. Units of exposure and dose.

UNIT IV

Radiation protection and safety, Safety of non- ionizing and ionizing radiation,Stochastic and non-Stochastic effects, Risk Factors, Safety limits. Principles of radiation dosimetery, Internal and external dosimetry.

Text Books

1. H. E. Johns and J. R. Gunningham,The physics of radiology, SpingerVerlag N.Y, 2004
2. Saha G, Physics and Radiobiology in Nuclear Medicine, Springer Verlag N.Y. 2003
3. Lombardi M H, Radiation Safety in Nuclear Medicine, Crc Press, 1988.
4. G.S Pant, Basic Physics and Radiation Safety in Nuclear Medicine, Crc Press, 2009

Reference Book

1. R. F. Mould, Quality control of Nuclear Medicine instrumentation, IPSM. York, 2010

BM-612MODELLING OF PHYSIOLOGICAL SYSTEMS LABORATORY **0-0-3 = 2**

Subject Code: *BM-612*
Subject Name: *Modelling of physiological systems laboratory*
No. of Hours Per Week: *Practicals-3.*
Marks Distribution: *Sessional Work = 20, End Semester Examination = 30.*
Minimum number of Experiments to be carried out: *Eight.*
***Question to be answered*:** *One experiment will be allotted to a student on lottery basis.*
Duration of End Semester Examination: *Four Hours*

List of experiments:-

1. Show a sine wave of 5 volt peak to peak amplitude in a scope using SIMULINK. Perform following operation on sine wave using SIMULINK tools like Amplification, Rectification, Integration, and Differentiations etc.
2. Simulate the SIMULINK model for the transfer function (s^2+420s/s^2+620s+4000), show the response for different input signals like sine wave, cosine wave, impulse and unit step of the transfer function.
3. Find out how much tidal volume is delivered to a patient in the intensive care unit when the peak pressure of a ventilator is set a prescribed level. For this operation use SIMULINK whenvarious pulmonary parameter as follows: R_c=1 cmH_2OL^{-1}, R_p=0.5 cmH_2OL^{-1} , C_w=0.2 cmH_2OL^{-1} C_s=0.005 cmH_2OL^{-1}.
4. Simulation of cardiovascular system model and study the variation of cardiac output volume on change in heart rate, stroke volume etc.
5. Simulation of cardiovascular system model and study the of the under different physiological conditions like exercise, myocardial infraction etc.
6. Simulate muscle stretch model using SIMULIK and perform steady-state analysis while changing the values of Efferent neural frequency (f_e)with respect to muscle length (L).
7. Simulate the model to determine the steady-state operating point of the ventilator control system.
8. Implement the SIMULINK model for the neuromuscular reflex model.
9. Simulation of Blood glucose regulatory system model and study of the variation of blood glucose level under normal Type I and Type II diabetes condition..
10. Study of root locus and bode plot for physiological control system.

Text Book

1. Michael C. K. Khoo, Physiological Control System,Wiley& Sons

BM-616 HARDWARE DESIGN PROJECT LABORATORY **0-0-3 = 2**

Subject Code: *BM-616*
Subject Name: *Hardware Design Project Laboratory.*
No. of Hours Per Week: *Practicals-3.*
Marks Distribution: *Sessional Work = 20, End Semester Examination = 30.*
Minimum number of Experiments to be carried out: *One working hardware design project.*
***Question to be answered*:** *Demonstration of hardware designed by student and viva.*
Duration of End Semester Examination: *Four Hours*

1. Student can opt any hardware design project directly related to the applied field of Biomedical Engineering.
2. Students have to submit their project individually or in groups but not more than three in one group. Topic and summary for hardware design project with names of student involved is first submitted by the students to the Head of Department then each group or individual is allotted a faculty member to guide for designing and devote 3 hours per week of his project work.
3. Evaluation of hardware design project in End semester is done by giving demonstration with viva voice.

BM-617 SEMINAR & GROUP DISCUSSION **0-0-3=2**

Subject Code: *BM-617*
Subject Name: *Seminar & group discussion*
No. of Hours Per Week: *Seminar-3.*
Marks Distribution: *Sessional Seminar = 20, End Semester Seminar Report = 30.*
Question to be answered**:** V*iva regarding topic.*
Duration of End Semester Examination: *Four Hours*

1. In Seminar and Group discussion, Students must have to submit their topic of seminar at beginning of 6^{th} semester. They can choose any topic related to the field of Biomedical Engineering. Need to be discussing with the departmental faculties and prepare a presentation of not more than 20 slides. Each student will deliver their lecture for 20 minutes, and after that the question and answer session will be for 10 minutes.
2. There will be a group of six students per week and the total time duration will be for 3 hrs. One who completed their seminar; they should submit their seminar reports within 15 days from the delivery of their presentation. Then the reports will be evaluated by the departmental faculties for evaluation. If it is not satisfactory, they will be asked for resubmission.

9. SEVENTH SEMESTER PAPERS

BM – 701 BIO-NANOTECHNOLOGY **3-1-0 = 4**

Subject Code: *BM - 701.*
Subject Name: *Bio-Nanotechnology*
No. of Hours Per Week: *Lectures-3, Tutorial-1*
Marks Distribution: *Sessional Work = 60, End Semester Examination = 90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any five.*
Duration of End Semester Examination: *Three Hours.*

Unit I

Introduction to Bio nanotechnology**:** Cellular nanostructures, self-assembly of colloidal nanostructures of biological relevance.

Unit II

Nanoparticles for drug delivery (including solid lipid nanoparticles, synthetic and biopolymeric nanoparticles), carbon nanotubes, polymeric nanofibers, Implications in neuroscience, tissue engineering and cancer therapy and Environmental and safety aspects of bio-nanotechnology.

Unit III

Multilayer Thin Film**:** Polyelectrolyte multilayers, coated colloids, smart capsules, LbL self-assembly.

Unit IV

Nano-engineered biosensors, fibre Optic Nano-sensors in medical care, Semiconductor and Metal Nanoparticles: Synthesis and Applications. Nanotechnology in Tissue Engineering, Micro emulsions and drug delivery.

Texts Books

1. Gero Decher, Joseph B. Schlenoff, Multilayer Thin Films, Wiley-VCH Verlag GmbH & Co. KGaA, 2003.
2. David S. Goodsell, Bionanotechnology: Lessons from Nature, Wiley-Liss, 2004.
3. Kenneth J. Klabunde, Nanoscale Materials in Chemistry. , John Wiley & Sons, Inc., 2001.

Reference Books

1. Bharat Bushan, Handbook of Nanotechnology, 2/e, Springer-Verlag Heidelberg, 2007.
2. K.E. Drexler, Nanosystems, John-Wiley Inc, 1992.
3. Morinubo Endo, SumioIijima, MS.Dresselhaus, Carbon Nanotubes, Pargamon, Elsevier Science, 1996.
4. Edward L Wolf, Nanophysics and Nanotechnology, Wiley-VCH Verlag, 2004.
5. S. D. Lyshevski, Nano- and Microelectromechanical Systems, CRC Press, 2001.

BM 702 HOSPITAL MANAGEMENT **3-1-0 = 4**

Subject Code: *BM - 702*
Subject Name: *Hospital Management*
No. of Hours Per Week: *Lectures-3, Tutorial-1.*
Marks Distribution: *Sessional Work = 60, End Semester Examination =90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any five.*
Duration of End Semester Examination: *Three Hours*

UNIT I

Organisation and Planning of the Hospital: Organisational structure: Governance, Duties and responsibilities of the governing board, Management structure: Duties, responsibilities and functions of the CEO, Hospital information System: Benefits, Organisation, Layout, Survey, Financial planning, Equipment planning.

UNIT II

Medical, Auxiliary Services and Nursing Services: Emergency services, Clinical laboratories, Radiological services, Diagnostic radiology, Radiation therapy department, Nuclear Medicine, Surgical Department, Physical Medicine and Rehabilitation, CATH lab, OT: Design and related equipment. General nursing unit, Central Nurse Station, Paediatric nursing unit, Isolation rooms, Intensive Care Unit(ICU), Coronary Care Unit(CCU), New-born nurseries. Electrical system, Air conditioning services, Centralised gas system, Communication systems, Transportation, CSSD, MEDICAL.

UNIT III

Engineering and Biomedical Engineering Department: Engineering department: Functions, Location, Design, Organization, Maintenance management. Biomedical Engineering department: Functions, Designs, Space facilities, Utilities, Hospital wiring system.

UNIT IV

Safety and Security in the Hospital: Hospital safety rules, Security and loss prevention, Fire safety, Bomb threat, Alarm systems, Disaster and Disaster preparedness plan, Safety codes for electrical and medical equipments, Medical standards for hospitals and equipment.

Text Books

1. G.B. Kunder and Gopinath, "Hospital Planning, Design and Management", Tata McGraw Hill.
2. S. L. Goel and R. Kumar, "Principles of Hospital Administration and Planning", Deep and Deep Publications.
3. Barry Feinberg, "Applied Clinical Engineering", Prentice Hall.
4. John Webster and Albert Cook, "Clinical Engineering Principles and Practices", Prentice Hall.
5. H. David Banta, Bryan Luce, "Health Care Technology and its Assessment", Oxford Medical Publications..

Reference Books

1. Operations Management in the Health Services; Planning Restructuring and Control: Nelson C.W.
2. Hospital Organisation and Management, S.P. Medical and Science Book Publication: Rakich J.S. Darr K.

Subject Code: *BM - 703*
Subject Name: *Medical Image Processing*
No. of Hours Per Week: *Lectures-3, Tutorial-1.*
Marks Distribution: *Sessional Work = 60, End Semester Examination =90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any five.*
Duration of End Semester Examination: *Three Hours*

UNIT I

Digital Imaging Processing System: Image acquisition storage, processing, communication display. Visual perception: Structure of Human Eye, Image formation in human eye, brightness and contrast, adaptation and discrimination, Block's Law and critical fusion frequency photographic film characteristics.

UNIT II

Image Model: Uniform and non-uniform sampling, quantization, Image enhancement: Image smoothing, point operators, contrast manipulation, histogram modification, noise clipping image sharpening, spatial operators, frequency domain method, low pass and high pass filtering, holomorphic filtering, median filtering.

UNIT III

Image Transforms: DFT, Properties of 2D Fourier Transforms, Sine and Cosine Transforms, Hadamass Transforms. Image Restoration: Degradation Model, A prior knowledge required in restoration, Inverse filtering, Weiner Filtering, Interactive restoration. Image Segmentation: Detection of discontinuity, point line and edge detection and boundary detection, Thresholding, Image interpretation.

UNIT IV

Biomedical Applications: Computer Tomography, Emission Tomography, CAT, Radon Transform CAT, MRI Images. Processing of Radiograph, Angiogram, Sonography including Doppler, Projection Theorem, Back projection.

Text Books

1. Digital Image Processing: R.C.Gonsalez, R.E. Woods.
2. Fundamental of Image Processing: Anil Kr. Jain.

Reference Book

1. Digital Image Processing: William Pratt (John Wiley)

HU - 704 INDUSTRIAL ECONOMICS AND MANAGEMENT **3-1-0 = 4**

Subject Code: *HU -704*
Subject Name: *Industrial Economics and Management*
No. of Hours Per Week: *Lectures-3, Tutorial-1.*
Marks Distribution: *Sessional Work = 60, End Semester Examination =90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any five.*
Duration of End Semester Examination: *Three Hours*

UNIT I

Concept of demand and supply, elasticity of demand, types of market structure, firm and industry, business cycle, input and out analysis, plant location decision, types of cost.

UNIT II

Production process, types of production, plant layout, production planning and control processes, human resource functions, emotional intelligence, inventory control techniques, work and method study, productivity concept.

UNIT III

Management principles and functions, managerial skills, decision making process, types of organization structures, Maslow's hierarchy of needs, types of communication, leader ship styles.

UNIT IV

Marketing concept, factors affecting consumer behaviour, types of market segments, product life cycle, pricing methods, distribution channels, advertising and sales promotion, value engineering.

Text Books

1. R. R. Barthwal, Industrial Economics: An Introductory Text Book, New Age, 2000.
2. Ahuja, H, L., Managerial Economics, S. Chand and Company Ltd., New Delhi, 2007.
3. Murugan, M and Sakthivel, Management Principles and Practices , New Age
4. International Publishers, New Delhi, 2008.
5. Aswathapa, K, Human Resource and Personnel Management, TMH, New Delhi, 2005.
6. Chary, S.N, Production and Operations Management, TMH, 2007.

Reference Books

1. Kotler, Keller, Koshy, Jha, Marketing Management-A South Asian Perspective, PearsonLtd., 2009.
2. Luthans, Fred, Organizational Behaviour, TMH, New Delhi, 2003

Elective-II (open)

BM – 70511 TELEMEDICINE **3-1-0 = 4**

***Subject Code: BM** – 70511.*
***Subject Name:** Telemedicine*
***No. of Hours Per Week:** Lectures-3, Tutorial-1*
***Marks Distribution:** Sessional Work = 60, End Semester Examination = 90.*
***Questions to be set:** Eight (one from each unit and remaining four from the combination of more than one unit).*
***Questions to be answered:** Any five.*
***Duration of End Semester Examination:** Three Hours.*

UNIT I

Fundamental concepts, Significance, Principle, functional blocks of Telemetry and Telecontrol system, Methods of telemetry, Electrical, Pneumatic, Hydraulic and Optical Telemetry, State of art- Telemetry standards.

UNIT II

Clinical network, Clinical parameters, Cardiology, Dermatology, Tele-radiology, EMI emergency medicine, Gastroenterology, Homecare, Neurology, Oncology, Ophthalmology, Mental health, Tele-rehabilitation, Tele-pathology & Tele-surgery.

UNIT III

Use of computers in distance mode of healthcare delivery, Web technology, Satellite communication systems; hypertext, voice & image transfer protocols, Medical image scanning, Data compression and Transfer, Capturing of medical signals, Analog to digital conversion, Video conferencing, Remote sensing, Rural primary setups, Referral and Super speciality centres, Societal medico legal aspects, Networking (local, national & global).

UNIT IV

Video conferencing hardware/software, Video production, Editing and Broadcasting, Tele-medical workstations, DSL equipment's, Cable modem, POTS line, Fast switches Ethernet, Fibre optic equipment, Router, Hubs, Monitoring devices, Vital sign monitoring devices, Respiratory monitoring devices, Neurological monitoring devices, Video scopes, Robotics and virtual reality devices. Legal and ethical issues, Duty of care, Malpractice and liability, Licensure and accreditation, Security and confidentiality, Ethical standards, Intellectual property rights.

Text Books

1. B. D. Gupta, "Introducing Telemedicine (Applications, challenges, needs and benefits,components and infrastructure)".
2. A. C. Norris, "Essentials of Telemedicine and Telecare"
3. Marlene Maheu, Pamela Whitten, Ace Allen, "E-health, Telehealth and Telemedicine"
4. Marilyn J. Field, Telemedicine: A Guide to Assessing Telecommunications for Health Care,National Academic Press, 1996.

Reference Books

1. Charles J. Amlaner (Author), David W. Macdonald (Author), A Handbook on Biotelemetry and Radio Tracking, Pergamon Press; 1st edition (January 1, 1980).

Elective-II(open)

BM- 70512 ARTIFICIAL INTELLIGENCE AND ITS APPLICATIONS IN BIOMEDICAL ENGINEERING **3-1-0 = 4**

***Subject Code: BM** – 70512.*
***Subject Name:** Artificial Intelligence & its Applications in Biomedical Engineering*
***No. of Hours Per Week:** Lectures-3, Tutorial-1*
***Marks Distribution:** Sessional Work = 60, End Semester Examination = 90.*
***Questions to be set:** Eight (one from each unit and remaining four from the combination of more than one unit).*
***Questions to be answered:** Any five.*
***Duration of End Semester Examination:** Three Hours.*

UNIT-I

Introduction to Artificial neuron and neural networks, feature selection. Types of learning, supervised and unsupervised learning, supervised learning decision surfaces, two category separation, linearly separable sets, multiple category classification problems. Relationship to neural network models, comparison of methods, applications.

UNIT-II

Unsupervised learning, clustering, kohonen network and competitive learning, Hebbian learning, Adaptive Resonance Theory(ART), applications.

UNIT III

Introduction & foundation of Fuzzy system, Fuzzy system at work; Fuzzy system design, Crips v/s Fuzzy sets, Fuzzy sets to fuzzy even, fuzzy logic, practical fuzzy measures, fuzzy set operation, properties of fuzzy sets, fuzzification techniques, relational inference, compositional inference, linguistic variable and logic operation, inference using fuzzy variable, fuzzy implications.

UNIT IV

Fuzzy system and algorithms, Defuzzification, adaptive fuzzy system algorithm, expert system v/s fuzzy inference engines, basic fuzzy inference algorithm. Evaluating antecedent fuzzy variables, left hand side computation; right hand side computation. Introduction to Genetic algorithm, Application of AI in biomedical engineering

Text Books

1. Donna L. , Hudson and Maurice E. Cohen,"Neural Networks and artificial Intelligence for Biomedical Engineering", Prentice Hall of India. Pvt., Ltd., New Delhi, 2011.
2. Riza C, Berkan and Sheldon L. Trubatch., "Fuzzy system Design Principles", Standard Publishers and distributors, Delhi.

Reference Book

1. J.S.R Jang, C.T. Sun and E Mizutani, "Neuro, Fuzzy and soft computing", Prentice Hall of India. Pvt., Ltd., New Delhi, 2010.

Elective-II(open)

BM – 70513 LASER & FIBER OPTICS AND ITS MEDICAL APPLICATION **3-1-0 = 4**

Subject Code: BM *– 70513.*
Subject Name: *Laser & fiber optics and its medical application*
No. of Hours Per Week: *Lectures-3, Tutorial-1*
Marks Distribution: *Sessional Work = 60, End Semester Examination = 90.*
Questions to be set: *Eight (one from each unit and remaining four from the combination of more than one unit).*
Questions to be answered: *Any five.*
Duration of End Semester Examination: *Three Hours.*

UNIT I

Introduction to Fiber Optics: Basic fiber link, applications, principles of light: Introduction, EM spectrum, internal & external reflections, Snell' slaw, optical fiber numerical aperture, Fresnel reflection.

UNIT II

Optic Fiber and its Properties: Introduction, Basic fiber construction, propagation of light, modes of operation, refractive index profile, types of fibers, dispersion, data rate and bandwidth, attenuation, losses. Connectors, Splices & Couplers: Introduction, splices: mechanical, fusion, protection of splice, connectors: SMA, STC, bionic etc, coupling: passive, Stan, TEE types. Optical sources & Photo Detectors: Introduction: creation of photons, LED, ILD.

UNIT III

Modulation Scheme for Fiber Optics Transmission: Introduction, digital modulation, analog modulation schemes, multiplexing. Laser Systems: Introduction, types of lasers: Solid state lasers, Gas lasers, Dye lasers, Lasers used in medical practice: Ruby laser, CO2 laser, Nd-YAG laser and related solid state laser

UNIT IV

Photo Detectors: introduction, PIN photodiode, avalanche photodiode, photodiode parameters, detector noise, speed of response, SNR Laser -Tissue Interaction: Terminology: spectral band designations, energy & power, irradiant & radiant exposure, fluency, thermal diffi1sion fibers& contact tips, Types of laser-tissue interactions. Laser application in medical therapy.

Text Books

1. Therapeutic Lasers -Theory and practice by G. David Baxter, Churchill Livings tone publications.
2. Medical Lasers and their safe use by David H Shiney, Stephen and L. Trokel, Springer-Verlag publications.
3. Elements of fiber optics by S. L. Wymer, Regents-Prentice Hall publications.
4. Biomedical Electronics & Instrumentation by S. K. Venkata Ram, Galgotia publications.

Reference Books

1. Laser and optical fibers in medicine by Katzer and Abraham, Academic press publications
2. An Introduction to optical fibers by A. M. Cherin, McGraw Hill publications

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Elective-II (open)

BM – 70514 VIRTUAL INSTRUMENTATION **3-1-0 = 4**

***Subject Code: BM** – 70514.*
***Subject Name:** Virtual Instrumentation*
***No. of Hours Per Week:** Lectures-3, Tutorial-1*
***Marks Distribution:** Sessional Work = 60, End Semester Examination = 90.*
***Questions to be set:** Eight (one from each unit and remaining four from the combination of more than one unit).*
***Questions to be answered:** Any five.*
***Duration of End Semester Examination:** Three Hours.*

UNIT 1

Review of Virtual Instrumentation, Historical perspective, Need of VI, Advantages of VI, Define VI, block diagram & architecture of VI, data flow techniques, graphical programming in data flow, comparison with conventional programming. Programming Techniques, VIS & Sub VIS, loops & charts, arrays, clusters, graphs, case & sequence structures, formula modes, local and global variable, string & file input.

UNIT II

Data Acquisition basics, ADC, DAC, DIO, Counters & timers, PC Hardware structure, timing, interrupts, DMA, Software and Hardware Installation.

UNIT III

Common Instrument Interfaces for Current loop, RS 232C/Rs 485, GPIB, System basics, interface basics: USB, PCMCIA, VXI, SCXI, PXI etc, networking basics for office & industrial application VISA & IVI, image acquisition & processing, Motion Control.

UNIT IV

Use of Analysis Tools, Fourier transforms Power spectrum, Correlation methods, windowing & flittering. Application of VI: Application in Process Control Designing of equipments like Oscilloscope, Digital Multimeter using Lab view Software, Study of Data Acquisition & control using Lab view Virtual instrumentation for an Innovative Thermal Conductivity Apparatus to measure the Thermal Conductivity Apparatus- to measure the conductivity of non-Newtonian fluids white they are subjected to sharing force.

Text Books

1. Virtual instrumentation using Lab View, Sanjay gupta, Tata McGraw Hill Publishing, first reprint, 2006.
2. Labview Graphical Programming, "Gary Johnson", second edition, MC GrawHill, Newyork, 1997
3. Labview for everyone, "Lisa K. Wells &Jettrey Travis", Prentice Hall, New Jersey, 1997.
4. Basic Concepts of Labview 4, "Sokoloff", Prentice Hall, New Jercy, 1998.

Reference Book

1. PC interfacing for Data Acquisition & process control, "S. Gupta, J.P.Gupta", second Edition, Instrument Society of America, 1994.

BM - 711 BIONANOTECHNOLOGY LABORATORY **0-0-3 = 2**

Subject Code: *BM-711*
Subject Name: *Bionanotechnology Laboratory*
No. of Hours Per Week: *Practicals-3.*
Marks Distribution: *Sessional Work = 20, End Semester Examination = 30.*
Minimum number of Experiments to be carried out: *Eight.*
***Question to be answered*:** *One experiment will be allotted to a student on lottery basis.*
Duration of End Semester Examination: *Four Hours*

List of Experiments:-

1. To visit SAIF and familiarization with sophisticate analytical instruments like TEM, SEM, AFM etc.
2. To prepare drug loaded nanoparticles from different polymers like chitosan.
3. Demonstration of nanoparticles by using TEM, SEM, DLS, zeta potential tools.
4. Demonstration of drug encapsulation efficiency.
5. Stability study of nanoparticles.
6. Drug release studies from nanoparticles at Physiological conditions.
7. Drug release studies from nanoparticles at Temperature triggered conditions.
8. Drug release studies from nanoparticles at: pH triggered conditions.

Text Books

1. Gero Decher, Joseph B. Schlenoff, Multilayer Thin Films, Wiley-VCH Verlag GmbH & Co. KGaA, 2003
2. David S. Goodsell, Bionanotechnology : Lessons from Nature, Wiley-Liss , 2004.

BM - 713 MEDICAL IMAGE PROCESSING LABORATORY **0-0-3 = 2**

Subject Code: *BM-713*
Subject Name: *Medical Image Processing Laboratory*
No. of Hours Per Week: *Practicals-3.*
Marks Distribution: *Sessional Work = 20, End Semester Examination = 30.*
Minimum number of Experiments to be carried out: *Eight.*
***Question to be answered*:** *One experiment will be allotted to a student on lottery basis.*
Duration of End Semester Examination: *Four Hours*

List of Experiments:-

1. Study of different images for different imaging modality like Ultrasound, X-ray, Computed Tomography and Magnetic resonance imaging.
2. Write a program in MATLAB
    a) To draw white rectangle (20pixel X 10 pixels) inside the black square (40 square pixels).
    b) To draw a black circle which have a diameter 20 pixels inside a 40 square pixel white box.
    c) To draw a English alphabet H.
    d) To draw three squares (10pixel X 10pixel) cascaded color of red, green and blue.
3. Write a program for histogram equalization.
4. Write a program to draw the histogram of provided image and on the basis of histogram perform multilevel threshold.
5. Write a program for the edge detection using Roberts, prewitt, sobel edge detector.
6. Write a program to convert RGB color model into HSV color model for the any color image.
7. Write a program to calculate different morphological features (Area, perimeter, major axis, minor axis) of an object in a given image.
8. Write a program to add salt and paper noise than apply median filter and comment on result.
9. Design a GUI and add following functionality
    a) A button for load an image
    b) A brightness adjustment bar
    c) A contrast adjustment bar
10. Write a program to count number of objects in given image and level objects.

Text Book

1. Rafael C., Gonzalez and Richard E. Woods, Digital Image Processing, Pearson Education Asia, 2001
2. Anil K. Jain, Fundamentals of Digital Image Processing, Prentice Hall of India, 1997
3. Webb, S., The Physics of Medical Imaging, AdernHilger, Bristol & Philadelphia. 2010
4. R. C. Gonzalez, R. E. Woods, S. L. Eddins , Digital Image Processing Using MATLAB(R),Course Technology, 1 edition, 2004

10. EIGHTH SEMESTER PAPERS

BM- 815 MAJOR PROJECT **0-0-20=20**

Major projects: Students can carry out their major projects in the department under the supervision of at least one teacher. They can also opt to carry out their projects outside NEHU with the collaboration of other National Institutes/ National laboratories/ Industries within India or abroad, in that case student needs to take a co-supervisor from the department and also needs to take permission from the department supervisor as well as from the HOD. In exceptional cases permission may be granted from the Head of the Institution.

Selection of the supervisor(s) and topic of interest needs to be finalised at the end of 6th semester to the HOD itself. Students need to submit a project synopsis on their respective topic in the GP-IV (General Proficiency IV) curriculum of 7th semester. At the end of project, students need to submit their project reports and also deliver their project presentation.

BM 617

In Seminar and Group discussion, Students must have to submit their topic of seminar at beginning of 6th semester. They can choose any topic related to the field of Biomedical Engineering. Need to be discussing with the departmental faculties and prepare a presentation of not more than 30 slides. Each student will deliver their lecture for 20 min, and after that the question and answer session will be for 10 min.

There will be a group of six students per week and the total time duration will be for 3 hrs. One who completed their seminar, they should submit their seminar reports within 15 days from the delivery of their presentation. Then the reports will be evaluated by the departmental faculties for evaluation. If it is not satisfactory, they will be asked for resubmission.

GP IV

Under this paper, the students shall be evaluated by fifty percent marks through the class performances, assignments etc. And the rest fifty percent will be for the project synopsis which will be carried out in the 8th Semester.
The project synopsis must have to submit to their respective supervisor for evaluation. The students who will carry their major projects outside NEHU, they also need to submit their synopsis. The synopsis must be signed by their Supervisor and Co-Supervisor (if applicable).