SCHEME AND SYLLABI

FOR

THIRD TO EIGHTH SEMESTERS

OF

BACHELOR OF TECHNOLOGY

IN

BIOMEDICAL ENGINEERING

FROM 2009 ADMISSION ONWARDS

CALICUT UNIVERSITY (P.O), THENHIPALAM

University of Calicut

B. Tech. Biomedical Engineering

3rd Semester

Code	Subject	Hours/week			Marks		Sem-end duration-hours	Credits
		L	T	P/D	Inte-rnal	Sem-End		
EN09 301	Engineering Mathematics III	3	1	-	30	70	3	4
EN09 302	Humanities and Communication Skills	2	1	-	30	70	3	3
BM09 303	Life Science	4	1	-	30	70	3	5
BM09 304	Electrical Technology	3	1	-	30	70	3	4
BM09 305	Digital Principles and Design	3	1	-	30	70	3	4
BM09 306	Analog Electronics	3	1	-	30	70	3	4
BM09 307(P)	*Basic Electronics Lab*	-	-	3	50	50	3	2
BM09 308(P)	*Electrical Engineering Lab*	-	-	3	50	50	3	2
	Total	**18**	**6**	**6**				**28**

4th Semester

Code	Subject	Hours/week			Marks		Sem-end duration-hours	Credits
		L	T	P/D	Inte-rnal	Sem-End		
EN09 401B	Engineering Mathematics IV	3	1	-	30	70	3	4
EN09 402	Environmental Science	2	1	-	30	70	3	3
BM09 403	Signals and Systems	4	1	-	30	70	3	5
BM09 404	Electronic Instrumentation	3	1	-	30	70	3	4
BM09 405	Linear Integrated Circuits	3	1	-	30	70	3	4
BM09 406	Microprocessors and Interfacing	3	1	-	30	70	3	4
BM09 407(P)	*Electronic Circuits Lab*	-	-	3	50	50	3	2
BM09 408(P)	*Digital Electronics Lab*	-	-	3	50	50	3	2
	Total	**18**	**6**	**6**				**28**

5th Semester

Code	Subject	Hours/week			Marks		Sem-end duration-hours	Credits
		L	T	P/D	Inte-rnal	Sem-End		
BM09 501	Digital Signal Processing	4	1	-	30	70	3	5
BM09 502	Medical Physics	3	1	-	30	70	3	4
BM09 503	Advanced Microprocessors and Microcontrollers	3	1	-	30	70	3	4
BM09 504	Computer Organization and Architecture	3	1	-	30	70	3	4
BM09 505	Biosensors and Transducers	3	1	-	30	70	3	4
BM09 506	Medical Instrumentation	2	1	-	30	70	3	3
BM09 507(P)	*Medical Electronics Lab*	-	-	3	50	50	3	2
BM09 508(P)	*Microprocessors and Microcontrollers Lab*	-	-	3	50	50	3	2
	Total	**18**	**6**	**6**				**28**

6th Semester

Code	Subject	Hours/week			Marks		Sem-end duration-hours	Credits
		L	T	P/D	Inte-rnal	Sem-End		
BM09 601	Bio-signal Processing Techniques and Applications	4	1	-	30	70	3	5
BM09 602	Engineering Economics and Principles of Management	3	1	-	30	70	3	4
BM09 603	Medical Imaging Techniques	3	1	-	30	70	3	4
BM09 604	Control Systems	3	1	-	30	70	3	4
BM09 605	Biomedical Equipments and Biophotonics	2	1	-	30	70	3	3
BM09 Lxx	Elective I	3	1	-	30	70	3	4
BM09 607(P)	*Biomedical and Clinical Instrumentation Lab*	-	-	3	50	50	3	2
BM09 608(P)	*Mini Project*	-	-	3	50	50	3	2
	Total	**18**	**6**	**6**				**28**

Elective I

BM09 L01	Power Electronics
BM09 L02	Computer Networks
BM09 L03	Applications of Lasers in Medicine
BM09 L04	Digital Systems Design
BM09 L05	Hospital Engineering and Managgement

7th Semester

Code	Subject	Hours/week			Marks		Sem-end duration-hours	Credits
		L	T	P/D	Inte-rnal	Sem-End		
BM09 701	Digital Image Processing	4	1	-	30	70	3	5
BM09 702	Fundamentals of Bioacoustics	3	1	-	30	70	3	4
BM09 703	Biomaterials	2	1	-	30	70	3	3
BM09 704	Biomechanics	2	1	-	30	70	3	3
BM09 Lxx	Elective II	3	1	-	30	70	3	4
BM09 Lxx	Elective III	3	1	-	30	70	3	4
BM09 707(P)	*Medical Embedded Computing and Virtual Bio-Instrumentation Lab*	-	-	3	50	50	3	2
BM09 708(P)	*Biomedical Signal Processing Lab*	-	-	3	50	50	3	2
BM09 709(P)	*Project*	-	-	1	100	-	-	1
	Total	**17**	**6**	**7**				**28**

8th Semester

Code	Subject	Hours/week			Marks		Sem-end duration-hours	Credits
		L	T	P/D	Inte-rnal	Sem-End		
BM09 801	Communication Systems	4	1	-	30	70	3	5
BM09 802	Biomedical Optics & Microscopy Imaging	2	1	-	30	70	3	3
BM09 Lxx	Elective IV	3	1	-	30	70	3	4
BM09 Lxx	Elective V	3	1	-	30	70	3	4
BM09 805(P)	Seminar	-	-	3	100	-	-	2
BM09 806(P)	Project	-	-	11	100	-	-	7
BM09 807(P)	Viva Voce	-	-	-	100	-	-	3
	Total	**12**	**4**	**14**				**28**

Electives

BM09 L06	Embedded System Design
BM09 L07	DSP Controllers
BM09 L08	Advanced Medical Instrumentation
BM09 L09	Rehabilitation Engineering
BM09 L10	Principles of Radiography & Radiology
BM09 L11	Soft Computing Techniques
BM09 L12	Data Communication
BM09 L13	Advanced Signal Processing
BM09 L14	Fundamentals of BIOMEMS and Medical Micro devices
BM09 L15	Artificial Organs and Implants
BM09 L16	Bioinformatics
BM09 L17	Human Factors in Engineering and Design
BM09 L18	Robotics and Automation
BM09 L19	Regulation and Control of Physiological System

BM09 L20	Biostatistics
BM09 L21	Signal Compression
BM09 L22	Reliability and Quality Control
BM09 L23	Operations Research
BM09 L24	Virtual Instrumentation
BM09 L25	System Modeling and Parameter Estimation

Global Electives

AI09 L24	Mobile Communications
AI09 L25	Probability and Random Processes
BT09 L23	Bio-nanotechnology
CS09L24	Computer Based Numerical Methods
CS09 L25	Pattern Recognition
AN09 L25	Research Methodology
IT09 L23	Distributed Systems
IT09 L24	Management Information Systems
PE09 L23	Total Quality Management
PE09 L25	Entrepreneurship

THIRD SEMESTER

EN09 301: Engineering Mathematics III

(Common for all branches)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objective

This course provides a quick overview of the concepts and results in complex analysis that may be useful in engineering. Also it gives an introduction to linear algebra and Fourier transform which are wealths of ideas and results with wide area of application.

Module I: Functions of a Complex Variable (13 hours)

Functions of a Complex Variable – Limit – Continuity – Derivative of a Complex function – Analytic functions – Cauchy-Riemann Equations – Laplace equation – Harmonic Functions – Conformal Mapping – Examples: Z^n, sinz, cosz, sinhz, coshz, $(z+{}^1/_z)$– Mobius Transformation.

Module II: Functions of a Complex Variable (14 hours)

Definition of Line integral in the complex plane – Cauchy's integral theorem (Proof of existence of indefinite integral to be omitted) – Independence of path – Cauchy's integral formula – Derivatives of analytic functions (Proof not required) – Taylor series – Laurent series – Singularities and Zeros – Residues – Residue Integration method – Residues and Residue theorem – Evaluation of real integrals.

Module III: Linear Algebra (13 hours) - Proofs not required

Vector spaces – Definition, Examples – Subspaces – Linear Span – Linear Independence – Linear Dependence – Basis – Dimension – Ordered Basis – Coordinate Vectors – Transition Matrix – Orthogonal and Orthonormal Sets – Orthogonal and Orthonormal Basis – Gram-Schmidt orthogonolisation process – Inner product spaces –Examples.

Module IV: Fourier Transforms (14 hours)

Fourier Integral theorem (Proof not required) – Fourier Sine and Cosine integral representations – Fourier Transforms – Fourier Sine and Cosine Transforms – Properties of Fourier Transforms.

Text Books

Module I:
Erwin Kreysig, *Advanced Engineering Mathematics, 8e,* John Wiley and Sons, Inc.
Sections: 12.3, 12.4, 12.5, 12.6, 12.7, 12.9

Module II:
Erwin Kreysig, *Advanced Engineering Mathematics, 8e,* John Wiley and Sons, Inc.
Sections: 13.1, 13.2, 13.3, 13.4, 14.4, 15.1, 15.2, 15.3, 15.4

Module III:
Bernaed Kolman, David R Hill, *Introductory Linear Algebra, An Applied First Course,* Pearson Education.
Sections: 6.1, 6.2, 6.3, 6.4, 6.7, 6.8, Appendix.B.1

Module IV:
Wylie C.R and L.C. Barrett, *Advanced Engineering Mathematics*, McGraw Hill.
Sections: 9.1, 9.3, 9.5

Reference books

1. H S Kasana, *Complex Variables, Theory and Applications*, 2e, Prentice Hall of India.
2. John M Howie, *Complex Analysis*, Springer International Edition.
3. Shahnaz bathul, *Text book of Engineering Mathematics, Special functions and Complex Variables*, Prentice Hall of India.
4. Gerald Dennis Mahan, *Applied mathematics*, Springer International Edition.
5. David Towers, *Guide to Linear Algebra*, MacMillan Mathematical Guides.
6. Howard Anton, Chris Rorres, *Elementary Linear Algebra, Applications Version, 9e*, John Wiley and Sons.
7. Anthony Croft, Robert Davison, Martin Hargreaves, *Engineering Mathematics*, 3e, Pearson Education.
8. H Parthasarathy, *Engineering Mathematics, A Project & Problem based approach*, Ane Books India.
9. B V Ramana, *Higher Engineering Mathematics*, McGrawHill.
10. Sarveswara Rao Koneru, *Engineering Mathematics*, Universities Press.
11. J K Sharma, *Business Mathematics, Theory and Applications*, Ane Books India.
12. John bird, *Higher Engineering Mathematics*, Elsevier, Newnes.
13. M Chandra Mohan, Vargheese Philip, *Engineering Mathematics-Vol. I, II, III & IV.*, Sanguine Technical Publishers.
14. N Bali, M Goyal, C Watkins, *Advanced Engineering Mathematics, A Computer Approach, 7e*, Infinity Science Press, Fire Wall Media.
15. V R Lakshmy Gorty, *Advanced Engineering Mathematics-Vol. I, II.*, Ane Books India.
16. Sastry S.S., *Advanced Engineering Mathematics-Vol. I and II*., Prentice Hall of India.
17. Lary C Andrews, Bhimsen K Shivamoggi, *Integral Transforms for Engineers*, Prentice Hall of

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

EN09 302: Humanities and Communication Skills

(Common for all branches)

Teaching scheme **Credits:** 3

2 hours lecture and 1 hour tutorial per week

Objectives

- *To identify the most critical issues that confronted particular periods and locations in history*
- *To identify stages in the development of science and technology*
- *To understand the purpose and process of communication*
- *To produce documents reflecting different types of communication such as technical descriptions, proposals, and reports*
- *To develop a positive attitude and self-confidence in the workplace and*
- *To develop appropriate social and business ethics.*

Module I (8 hours)

Humanities, Science and Technology: Importance of humanities to technology, education and society- Impact of science and technology on the development of modern civilization.
Contributions of ancient civilization: Chinese, Indian, Egyptian and Greek.
Cultural, Industrial, Transportation and Communication revolutions.
Advances in modern India: Achievements in information, communication and space technologies.

Module II (9 hours)

Concept of communication: The speaker/writer and the listener/reader, medium of communication, barriers to communication, accuracy, brevity, clarity and appropriateness
Reading comprehension: Reading at various speeds, different kinds of text for different purposes, reading between lines.
Listening comprehension: Comprehending material delivered at fast speed and spoken material, intelligent listening in interviews
Speaking: Achieving desired clarity and fluency, manipulating paralinguistic features of speaking, task oriented, interpersonal, informal and semi formal speaking, making a short classroom presentation.
Group discussion: Use of persuasive strategies, being polite and firm, handling questions and taking in criticisms on self, turn-taking strategies and effective intervention, use of body language.

Module III (10 hours)

Written Communication : Note making and taking, summarizing, notes and memos, developing notes into text, organization of ideas, cohesion and coherence, paragraph writing, ordering information in space and time, description and argument, comparison and contrast, narrating events chronologically. Writing a rough draft, editing, proof reading, final draft and styling text.
Technical report writing: Synopsis writing, formats for reports. Introductory report, Progress report, Incident report, Feasibility report, Marketing report, Field report and Laboratory test report
Project report: Reference work, General objective, specific objective, introduction, body, illustrations using graphs, tables, charts, diagrams and flow charts. Conclusion and references
Preparation of leaflets, brochure and C.V.

Module IV (9 hours)

Human relations and Professional ethics: Art of dealing with people, empathy and sympathy, hearing and listening. Tension and stress, Methods to handle stress

Responsibilities and rights of engineers- collegiality and loyalty – Respect for authority – Confidentiality – conflicts of interest – Professional rights, Rights of information, Social responsibility. Senses of ethics – variety of moral issues – Moral dilemma – Moral autonomy – Attributes of an ethical personality – right action – self interest

Reference Books

1. Meenakshi Raman and Sangeeta Sharma, *Technical Communication- Principles and Practice* Oxford University press, 2006
2. Jayashree Suresh and B S Raghavan, *Professional Ethics*, S Chand and Company Ltd, 2005
3. Subrayappa, *History of Science in India*, National Academy of Science, India
4. R C Bhatia, *Business Communication*, Ane Books Pvt. Ltd, 2009
5. Sunita Mishra and C Muralikrishna, *Communicatin Skils for Engineers*, Pearson Education, 2007.
6. Jovan van Emden and Lucinda Becker, *Effective Communication for Arts and Humanities Students*, Palgrave macmillam, 2009
7. W C Dampier, *History of Science*, Cambridge University Press
8. Vesilind, *Engineering, Ethics and the Environment*, Cambridge University Press
9. Larson E, *History of Inventions*, Thompson Press India Ltd.
10. Bernal J.D, *Science in History*, Penguin Books Ltd
11. Encyclopedia Britannica, *History of Science*, *History of Technology*
12. Brownoski J, *Science and Human Values*, Harper and Row

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 303: Life Science

Teaching scheme **Credits:** 5

4 hours lecture and 1 hour tutorial per week

Objective

To give fundamental knowledge about anatomy and physiology of the human body especially

- *Cell biology, biochemistry, and microbiology*
- *Different systems of the human body*

Module I (18 hours)

Organization of life. Importance of water. Cell structure and organelles. Structure and function of biomolecules: Carbohydrates, Lipids, Proteins and Nucleic acids,Sodium potassium pump and cell potential. Cell separation, centrifugation. Biochemical separation techniques. Protein structure, folding and function: Myoglobin, Hemoglobin, Lysozyme, ribonuclease A, Carboxypeptidase and Chymotrypsin. Enzyme kinetics and regulation, Coenzymes. Metabolism and bioenergitics. Generation and utilization of ATP. Photosynthesis. Major metabolic pathways and their regulation. Biological membranes. Transport across membranes. Signal transduction; hormones and neurotransmitters., vitamins and mineral functions in the cell.DNA replication, transcription and translation. Biochemical regulation of gene expression. Recombinant DNA technology and applications. Genomics and Proteomics.

Historical perspective - Discovery of the microbial world; Controversy over spontaneous generation; Role of microorganisms in transformation of organic matter and in the causation of diseases.

Methods in microbiology - Pure culture techniques; Theory and practice of sterilization; Principles of microbial nutrition; Construction of culture media; Enrichment culture techniques for isolation of chemoautotrophs, chemoheterotrophs and photosynthetic microorganisms.

Module II (19 hours)

Basic body systems, medical terms, and vital signs; distinguish between symptoms and disease, pathology of cells, tissues, and glands; types of disease, and modes of disease transmission; recognize different medical specialties and specialists Medical terms and terminology, Define anatomy and physiology ,Human Body Orientation: anatomic position, parts and planes of the human body.

Anatomy and Physiology of the Musculoskeletal System., different bones in the body and their functions, bone structure and generation ,hydroxylapatite , bone matrix, bone reformation from fracture

Anatomy of Muscles in the body and function, sliding filament theory and muscle action potential.

The Nervous System: Central nervous system and Autonomic nervous system description of neuron function, anatomy and physiology of the nerves, principle of transmission of nerve

potential, neuromuscular junction, synapse and action of acetycholine. Ascending and descending tracts, sensory perception with special reference to pain, muscle tone, regulation of posture and equilibrium

Module III (18 hours)

Cardiovascular System- Heart ,Anatomy and physiology of heart, ECG norms waves —cardiac cycle, heart rate – heart sound –cardiac outputs.. BLOOD- The composition of blood, function blood groups, The immune system. Active and passive immunity. Complement system. Antobody structure, function and diversity. Cells of the immune system: T, B and macrophages. T and B cell activation. Major histocompatibilty complex. T cell receptor. Immunological techniques: Immunodiffusion, immunoelectrophoresis, RIA and ELISA.

Respiratory system: Anatomy and Physiology, Concepts of the organs concerned with the respiration and their structure and organization. Mechanics of respiration, physical principle of gaseous exchange transport of gases and control of respiration. Lung volume and capacities
Digestive System: Anatomy and physiology of the intestinal tracts, structure of digestive tract organs and associated glands –salivary gastric & intestinal digestion and motility of gastrointestinal tract

Module IV (17 hours)
The Skin and Sense Organs. Anatomy structure and function, organs of vision, hearing taste, sense of smell, tests of hearing audiometry. Endocrine System- Anatomy and physiology ,Elementary knowledge of function of various Endocrine glands, hormone and their effects. Urinary System: anatomy of nephron and kidney systems. Renal function –process involved in urine formation, micturition composition of urine, regulation of acid-base balance and principle of hemodialysis. Male and Female Reproductive Systems- Anatomy and physiology of reproductive system: male and female ,general plan of sex organs in male and female Functions of male reproductive organs & female reproductive organs & contraception , sexually transmitted diseases.

Text Books

1.D.W Martin, P. A . Mayes and V.W. Podwell,Harpers review of Bio Chemistry, Lange medical Pub. Asia.
2.A. C. Guyton : Textbook of Medical Physiology, 8th ed, Prism Books (Pvt) Ltd & W. B. Saunders Company, 1991.
3.Anantha Narayanan and Jaya ram Panicker," Textbook of Micro biology", Orient Longman.

Reference Books

1.Paul and Reich, Haematology, Physio Pathological Basis for Clinical Practice, Little Brown.
2.A.V .S.S Rama Rao, ,The Textbook of Bio Chemistry, L.K.&S Publications
3.Charles Herbral Best and Noorman Burke Taylor , “living body”,Chapman & Hall Ltd.
4.Dr.T.S.Ranganathan, “Text book of Human Anatomy” S.Chand &co.
5.Gord on sears and Winwood , “Anatomy and Physiology for Nurses” ZELPS4.
6.Anantha Narayan and Jayaram Panickar “Text book of Microbiology” Orient Longman.
7.Paul and Reich, “hematology Physio Pathological Basis for clinical Practice” Little Brown.

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 304: Electrical Technology

Teaching scheme **Credits: 4**

3 hours lecture and 1 hour tutorial per week

Objectives

To give fundamental knowledge about the following topics of electrical technology

- *DC machines and transformers*
- *AC machines*
- *Electrical measurements*

Module I: DC machines (13 hours)

Types of DC machines - DC Generators – emf equation – open circuit and load characteristics of different types of DC generators - DC motors - Principle of operation - Types - Torque equation - Characteristics - Starters.

Module II: Transformers (13 hours).

Transformers: Construction and principle of operation - emf equation - Phasor diagram - Equivalent circuit - OC and SC tests - Basic principles of autotransformer.

Module III: AC machines (14 hours)

Alternator (brief study)- Rotating field - emf equation - Losses and efficiency of synchronous motor -Torque equation - Induction motor - Constructional features (in brief) - Principle of operation of 3 phase induction motor - Vector diagram and equivalent circuits - Starting and speed control of squirrel cage and wound rotor induction motor.

Module IV: Electrical measurements (14 hours)

Principle of moving coil, moving iron and dynamometer type instruments - Extension of range of voltmeter and ammeter - DC slidewire, potentiometer - Wheatstone bridge - Kelvin's double bridge - AC bridges -Maxwell, Hay, Schering, and Wien bridges Measurement of 3-phase power by two wattmeter method, Principle of energy meter

Text Books

1. E. Hughes, Electrical & Electronic Technology, Pearson Education, Delhi.
2. W. H. Hayt Jr, J. E. Kemmerly, and S. M. Durbin, Engineering Circuit Analysis, Tata McGraw-Hill, New Delhi, 2002.

Reference Books

1. H. Cotton, Advanced Electrical Technology, CBS Publishers and Distributors, New Delhi
2. E. W. Golding and F. C. Widdis, Electrical Measurements and Measuring Instruments, AH Wheeler & Co., Calcutta
3. R. A, DeCarlo and P. Lin, Linear Circuit Analysis, Oxford University Press, New Delhi, 2001
4. D. A. Bell, Electronic Instrumentation and Measurements, Prentice Hall of India, New Delhi, 2003

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 305: Digital Principles and Design

Teaching Scheme **Credits: 4**

3 hours lecture and 1 hour tutorial per week

Objective

- *To introduce the concepts of digital logic systems. Topics covered are Boolean algebra, flip-flops, counters, shift registers, Digital IC technologies, and sequential networks.*

Module I (14 hours)

Analog and digital representation, Review of number systems-representation-conversions, r's and (r-l)'s complement representation. Binary codes-error detection and error correction. Review of Boolean algebra-theorems, sum-of product and product of sum simplification, canonical forms - minterm and maxterm, Simplification of Boolean expressions - Karnaugh map (upto 4 variables), completely and incompletely specified functions, Quine McCluskey method (upto 5 variables), implementation of Boolean expressions using universal gates.

Module II (13 hours)

Combinational logic circuits- adders, subtractors, BCD adder, ripple carry look ahead adders, parity generator, decoders, encoders, multiplexers, demultiplexers, Realisation of Boolean expressions- using decoders-using multiplexers. Memories - ROM- organisation, expansion. PROMs. RAMs - Basic structure, organization, Static and dynamic ROMs, PLDs, PLAs. Sequential circuits - latches, flip flops - SR, JK, D. T, and Master slave flip flops, edge triggering, asynchronous inputs.

Module III (14 hours)

Shift registers, Universal shift register, applications. Binary counters - Synchronous and asynchronous-up/down counters, mod-N counter, Counters for random sequence, Multivibrators - astable and monostable multivibrators using gates. Integrated circuit technologies - Characteristics and parameters. TTL Circuit-totem pole output-open collector-tristate gates-Schottky TTL, ECL.NMOS and PMOS logic, CMOS logic, BiCMOS and Gallium-Arsenide digital circuits.

Module IV (13 hours)

Synchronous sequential networks: structure and operation, analysis-transition equations, state tables and state diagrams, Introduction to algorithmic state machines, Modeling- Moore machine and Mealy machine- serial binary adder, sequence recogniser, state table reduction, state assignment. Asynchronous sequential circuit - basic structure, equivalence and minimization, minimization of completely specified machines, Introduction to RTL and VHDL.

Text Books

1. D. D. Givone, Digital Principles and Design, Tata Mc-Graw Hill, New Delhi.
2. M. M. Mano, Digital Design, 3rd ed., Pearson Education, Delhi

Reference Books

1. J. F. Wakerly, Digital Design Principles and practices, 3rd ed. Pearson, Pearson Education. Delhi, 2001
2. T. L. Floyd, Digital Fundamentals, 8th ed. Pearson Education Delhi, 2003.
3. W. H. Gothmann, Digital Electronics An Introduction to Theory and Practice, 2nd ed., Prentice Hall of ndia, New Delhi, 1995.
4. R. J. Tocci, Digital Systems Principles and Applications, 6th ed. Prentice Hall of India, New Delhi

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

Note: One of the assignments shall be simulation of digital systems using any technical software.

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 306: Analog Electronics

Teaching Scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objective

- *This course is designed us a foundation course in the field of analog electronic circuits. Analysis of electronic circuits using BJT, FET, UJT, MOSFET, etc. is covered.*

Module I (14 hours)

General characteristics of amplifiers - Amplifier classification - Transistor hybrid model - CF, CB and CC configuration - Comparison - Analysis of Transistor amplifier using h-parameters - current gain, voltage gain, input impedance, and output impedance - The amplifier with emitter resistor - FET - Small signal model- Low frequency CS and CD amplifier - FET biasing.

Power amplifiers - Class A large signal amplifiers - Transformer coupled Class A power amplifier -efficiency, Push pull amplifiers - Class B push pull amplifier, class B push pull circuit with complementary symmetry, Class AB amplifier. Biasing the class AB circuit, Class C amplifiers,

Module II (13 hours)

Feedback amplifiers - principles of feedback in amplifiers, advantages of negative feedback, Voltage series, current series, voltage shunt and current shunt feedback circuits. Oscillators-criteria for oscillation-RC phase shift and Wien bridge oscillator, Hartley, Colpitts and crystal oscillator-frequency stability.

Module III (13 hours)

Enhancement type MOSFET - device structure, operation, current-voltage characteristics, depletion type MOSFET, DC analysis of MOSFET circuits, MOSFET as an amplifier- Biasing in MOSFET amplifier circuits, MOSFET as an analog switch, MOSFET internal capacitances and high frequency model, The MESFET UJT - Construction, Working principle and characteristics - UJT relaxation oscillator. Introduction to thyristors, thyristor characteristics, SCR characteristics

Module IV (14 hours)

Linear wave shaping ~ high pass and low pass circuits - analysis - steady state output for step, pulse, square wave and ramp inputs. Transistor as a switch-application-logic inverter, Ebers-Moll model of BJT-minority- carrier storage in the base of a saturated transistor. Basic operation of Bistable, Monostable and Astable multivibrators, Schmitt trigger circuit.

Different amplifier – The BJT differential pair – CMRR, input resistance, voltage gain, non-ideal characteristics of differential amplifier, current sources, active load, Basic principle of MOS differential amplifier.

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

Delhi, 2004.

4. D. A. Bell. Solid State Pulse Circuits, 4lh ed., Prentice Hall of India, New Delhi, 1999.
5. R. L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory, 8lh ed., Prentice

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 307(P): Basic Electronics Lab

Teaching scheme **Credits: 2**

3 hours practical per week

Objectives

- *To train the students to obtain the characteristic curves of semiconductor devices like diode, transistor, FET, and UJT.*
- *To provide experience on design, testing, and analysis of electronics circuits-clipping and clamping circuits, RC filters, rectifiers, amplifier, etc.*
- *To expose the students to simulation of electronic circuits using any software*

(Any 14 experiments)

1) Characteristics of diode and zener diode
2) Zener diode as voltage regulator
3) Characteristics of Transistor – Common emitter/Common Base configuration
4) Clipping circuits
5) Clamping circuits
6) UJT Characteristics
7) UJT Relaxation Oscillator
8) Frequency response of RC low pass filter and high pass filter
9) Rectifiers – Half wave, full wave, bridge with and without ripple factor and regulation.
10) Common emitter amplifier with four resistor bias circuit, and coupling and bypass capacitors – frequency response characteristics.
11) MOSFET as a switch and amplifier
12) Series voltage regulator with feedback
13) Emitter follower
14) Transistor as a switch-timing calculations
15) Power amplifiers – class A and class AB
16) Cascode amplifier
17) a) Introduction to any circuit simulation software, eg. PSPICE/EDSPICE/MULTISIM, etc.
    b) Simulation of following experiments
        i) Diode characteristics
        ii) Transistor/MOSFET characteristics
        iii) Rectifier circuits
        iv) Clipping and clamping circuits.
        v) RC Low pass and high pass fillers-frequency response.
        vi) Common emitter amplifier.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Laboratory practical and record
30% - Test/s
10% - Regularity in the class

Semester-End Examination *(Maximum Marks-50)*

70% - Procedure and tabulation form, Conducting experiment, results and inference
20% - Viva voce
10% - Fair record

BM09 308(P): Electrical Engineering Lab

Teaching scheme **Credits 2**

3 hours practical per week

Objectives

To provide practical experience to students in electrical instruments and machines especially

- *DC machines and transformers*
- *AC machines*

1.Plot open circuit characteristics of DC shunt generator for rated speed - Predetermine O.C.C. for other speeds -Determine critical field resistance for different speeds.

2.Load test on DC shunt generator - Plot external characteristics - Deduce internal characteristics

3.Load test on DC series motor - Plot the performance characteristics.

4.OC and SC tests on single phase transformer - Determine equivalent circuit parameters – Predetermine efficiency and regulation at various loads and different power factors - verify for unity power factor with a load test.

5.Load test on 3 phase-cage induction motor - Plot performance curves.

6.Resistance measurement using a) Wheatstone's bridge b) Kelvin's double bridge.

7.Measurement of self inductance, mutual inductance and coupling coefficient of a) Transformer windings b) air cored coil.

8.Power measurement in 3 phase circuit - Two wattmeter method.

9.Extension of ranges of ammeter and voltmeter using shunt and series resistances.

10. Calibration of single phase energy meter by direct loading.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Laboratory practical and record
30% - Test/s
10% - Regularity in the class

Semester-End Examination *(Maximum Marks-50)*

70% - Procedure and tabulation form, Conducting experiment, results and inference
20% - Viva voce
10% - Fair record

FOURTH SEMESTER

EN09 401B: Engineering Mathematics IV

(Common for IC, EC, EE, AI, BM, CS, and IT)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objective

Objective of this course is to inculcate the students an adequate understanding of the basic concepts of probability theory to make them develop an interest in the area which may find useful to pursue their studies. Also it is intended to stimulate the students understanding of the Z-transform. A study of some important partial differential equations is also included to make the student get acquainted with the basics of PDE.

Module I: Probability Distributions (13 hours)

Random variables – Mean and Variance of probability distributions – Binomial Distribution – Poisson Distribution – Poisson approximation to Binomial distribution – Hyper Geometric Distribution – Geometric Distribution – Probability densities – Normal Distribution – Uniform Distribution – Gamma Distribution.

Module II: Z Transforms (14 hours)

Introduction – The Z transform – Z transform and Region of Convergence (ROC) of finite duration sequences – Properties of ROC – Properties of Z-Transforms: Linearity, Time Shifting, Multiplication by exponential sequence, Time reversal, Multiplication by *n*, Convolution, Time Expansion, Conjugation, Initial Value Theorem, Final Value Theorem – Methods to find inverse transforms – long division method – partial fraction method – residue method – Solutions of difference equations using Z Transforms.

Module III: Series Solutions of Differential Equations (14 hours)

Power series method for solving ordinary differential equations – Legendre's equation – Legendre polynomials – Rodrigue's formula – Generating functions – Relation between Legendre polynomials – Orthogonality property of Legendre polynomials (Proof not required) – Frobenius method for solving ordinary differential equations – Bessel's equation – Bessel functions – Generating functions – Relation between Bessel functions – Orthogonality property of Bessel functions (Proof not required).

Module IV: Partial Differential Equations (13 hours)

Introduction – Solutions of equations of the form $F(p,q) = 0$; $F(x,p,q) = 0$; $F(y,p,q) = 0$; $F(z,p,q) = 0$; $F_1(x,q) = F_2(y,q)$; Clairaut's form, $z = px + qv + F(p,q)$; Legrange's form, $Pp + Qq = R$ – Classification of Linear PDE's – Derivation of one dimensional wave equation and one dimensional heat equation – Solution of these equation by the method of separation of variables – D'Alembert's solution of one dimensional wave equation.

Text Books

Module I:
Richard A Johnson, CB Gupta, *Miller and Freund's Probability and statistics for Engineers, 7e*, Pearson Education - Sections: 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 5.1, 5.2, 5.5, 5.7

Module II:
P Ramesh Babu, R Ananda Natarajan, *Signals and* Systems, 2e, Scitech Publications.
Sections: 10.1, 10.2, 10.3, 10.4, 10.5.1, 10.5.2, 10.5.3, 10.5.4, 10.5.5, 10.5.6, 10.5.7, 10.5.8, 10.5.12, 10.5.13, 10.6, 10.10

Module III:
Erwin Kreysig, *Advanced Engineering Mathematics, 8e*, John Wiley and Sons, Inc.
Sections: 4.1, 4.3, 4.4, 4.5

Module IV:
N Bali, M Goyal, C Watkins, *Advanced Engineering Mathematics, A Computer Approach, 7e*, Infinity Science Press, Fire Wall Media.
Sections: 16.1, 16.2, 16.3, 16.4, 16.5, 16.6, 16.7, 16.8, 16.9
Erwin Kreysig, *Advanced Engineering Mathematics, 8e*, John Wiley and Sons, Inc.
Sections: 11.2, 11.3, 11.4, 9.8 Ex.3, 11.5

Reference books

1. William Hines, Douglas Montgomery, avid Goldman, Connie Borror, *Probability and Statistics in Engineering*, 4e, John Wiley and Sons, Inc.
2. Sheldon M Ross, *Introduction to Probability and Statistics for Engineers and Scientists*, 3e, Elsevier, Academic Press.
3. Anthony Croft, Robert Davison, Martin Hargreaves, *Engineering Mathematics*, 3e, Pearson Education.
4. H Parthasarathy, *Engineering Mathematics, A Project & Problem based approach*, Ane Books India.
5. B V Ramana, *Higher Engineering Mathematics*, McGrawHill.
6. Sarveswara Rao Koneru, *Engineering Mathematics*, Universities Press.
7. J K Sharma, *Business Mathematics, Theory and Applications*, Ane Books India.
8. John bird, *Higher Engineering Mathematics*, Elsevier, Newnes.
9. M Chandra Mohan, Vargheese Philip, *Engineering Mathematics-Vol. I, II, III & IV.*, Sanguine Technical Publishers.
10. Wylie C.R and L.C. Barret, *Advanced Engineering Mathematics*, McGraw Hill.
11. V R Lakshmy Gorty, *Advanced Engineering Mathematics-Vol. I, II.*, Ane Books India.
12. Sastry S.S., *Advanced Engineering Mathematics-Vol. I and II*., Prentice Hall of India.
13. Michael D Greenberg, *Advanced Engineering Mathematics*, Pearson Education.
14. Larv C Andrews, Bhimsen K Shivamoggi, *Integral Transforms for Engineers*, Prentice Hall of

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

EN09 402: Environmental Science

(Common for all branches)

Teaching scheme **Credits:** 3

2 hours lecture and 1 hour tutorial per week

Objectives

- *To understand the problems of pollution, loss of forest, solid waste disposal, degradation of environment, loss of biodiversity and other environmental issues and create awareness among the students to address these issues and conserve the environment in a better way.*

Module I (8 hours)

The Multidisciplinary nature of environmental science, Definition-scope and importance-need for public awareness. Natural resources, Renewable and non-renewable resources:
Natural resources and associated problems-forest resources: Use and over exploitation, deforestation, case studies. Timber extraction, mining, dams and their defects on forests and tribal people.- water resources: Use and over utilization of surface and ground water, floods ,drought ,conflicts over water, dams-benefits and problems.- Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.- Food resources: World food problems, changes caused by agriculture over grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity,case studies.-Energy resources: Growing energy needs, renewable and non-renewable energy resources, use of alternate energy resources, Land resources: Land as a resource, land degradation, man induced land slides, soil erosion and desertification.

Module II (8 hours)

Ecosystems-Concept of an ecosystem-structure and function of an ecosystem – producers, consumers, decomposers-energy flow in the ecosystem-Ecological succession- Food chains, food webs and Ecological pyramids-Introduction, types, characteristics features, structure and function of the following ecosystem-Forest ecosystem- Grassland ecosystem –Desert ecosystem-Aquatic ecosystem(ponds, streams, lakes, rivers, oceans , estuaries)
Biodiversity and its consideration- Introduction- Definition: genetic, species and ecosystem diversity-Biogeographical; classification of India –value of biodiversity: consumptive use, productive use, social ethical , aesthetic and option values Biodiversity at Global, national , and local level-India at mega – diversity nation- Hot spot of biodiversity-Threats to biodiversity: habitat loss, poaching of wild life, man , wild life conflicts –Endangered and endemic species of India-Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity.

Module III (10 hours)

Environmental pollution- Definition-Causes, effects and control measures of Air pollution-m Water pollution –soil pollution-Marine pollution-Noise pollution-Thermal pollution-Nuclear hazards-Solid waste management: Causes, effects and control measures of urban and industrial wastes-Role of an individual in prevention of pollution-pollution case studies-Disaster management: floods, earth quake, cyclone and landslides-Environmental impact assessment

Module IV (10 hours)

Environment and sustainable development-Sustainable use of natural resources-Conversion of renewable energy resources into other forms-case studies-Problems related to energy and Energy auditing-Water conservation, rain water harvesting, water shed management-case studies-Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust-Waste land

reclamation-Consumerism and waste products-Reduce, reuse and recycling of products-Value education.

Text Books

1. Clark,R.S.Marine pollution,Clanderson Press Oxford.
2. Mhaskar A. K. Matter Hazrdous, Techno-science Publications.
3. Miller T. G. Jr., Environmental Science, Wadsworth Publishing Co.
4. Townsend C., Harper J, Michael Begon, Essential of Ecology, Blackwell Science
5. Trivedi R. K., Goel P. K., Introduction to Air Pollution, Techno-Science Publications.

Reference Books.

1. Raghavan Nambiar,K Text book of Environmental Studies,Scitech Publishers(India) Pvt. Ltd
2. Bharucha Erach, Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, Email: mapin@icenet.net
3. Cunningham, W.P., Cooper, T.H., Gorhani, E & Hepworth, M.T. 2001Environmental encyclopedia Jaico publ. House Mumbai 1196p
4. Down to Earth, Centre for Science and Environment
5. Hawkins, R.E. Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay
6. Mckinney, M.L. & School, R.M. 1996. Environmental Science system & Solutions, Web enhanced edition, 639p.
7. Odum, E.P. 1971. Fundamentals of Ecology. W.B.Saunders Co. USA, 574p
8. Rao, M.N. & Datta, A.K 1987. Waste Water treatment. Oxford & IBH Publ. Co. Pvt. Ltd., 345p
9. Survey of the Environment, The Hindu Magazine
10. Wagner.K.D. 1998. Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as Report of field work, literature survey, seminar etc.
10% - Regularity in the class

Note: Field work can be visit to a local area to document environmental assets-river/forest/grass land/mountain or Visit to local polluted site-urban/rural/industrial/agricultural etc. or Study of common plants, insects, birds etc. or Study of simple ecosystems-pond, river, hill slopes etc. or mini project work on renewable energy and other natural resources , management of wastes etc.

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 403: Signals and Systems

Teaching scheme **Credits 5**
4 hours lecture and 1 hour tutorial

Objectives

- *To impart the basic concepts of continuous and discrete signals and systems*
- *To develop understanding about frequency domain approaches for continuous and discrete time signals and systems.*
- *To establish the importance of z-transform and its properties for analysing discrete time signals and systems.*

Module I (18 hours)
Introduction to signals and systems-classification of signals-basic operations on signals-elementary signals-concept of system-properties of systems-stability, invertibility, time invariance, linearity, causality, memory, time domain description-convolution-impulse response-representation of LTI systems-differential equation and difference equation representation of LTI systems.

Module II (20 hours)
Fourier representation of continuous time signals- Fourier transform-existence of the Fourier integral-FT theorems-energy spectral density and power spectral density-frequency response of LTI systems-correlation theory of deterministic signals-condition for distortionless transmission through an LTI system- transmission of a rectangular pulse through an ideal low pass filter-Hubert transform-sampling and reconstruction

Module III (18 hours)
Fourier representation of discrete time signals- discrete Fourier series and discrete Fourier transform-Laplace Transform analysis of systems-relation between the transfer function and differential equation-causality and stability-inverse system-determining the frequency response from poles and zeroes

Module IV (16 hours)
Z-transform-definition- properties of the region of convergence- properties of the Z-transform-analysis of LTI systems-relating the transfer function and difference equation-stability and causality-tests of stability-inverse systems-determining the frequency response from poles and zeroes

Text Books

1. S. Haykin and B. V. Veen, Signals and Systems, John Wiley & Sons, N. Y
2. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, Signals & Systems, Prentice Hall of India, New Delhi

Reference Books

1.C. L. Philips, J. M. Parr, E. A Riskin, Signals, Systems and Transforms, 3rd ed., Pearson Education, Delhi

2.R. E. Zeimer, W. H. Tranter, and D. R. Fannin, Signals and Systems: Continuous and Discrete, Pearson Education, Delhi.

3.J. Roberts, Signals and Systems: Analysis using Transform methods and MATLAB, Tata McGraw Hill, New Delhi

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

Note: One of the assignments shall be simulation of continuous-time systems using any technical computing software

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

Note: *More than 75% of the questions shall be analytical/problem oriented types.*

BM09 404: Electronic Instrumentation

Teaching scheme **Credit: 4**

3 hours lecture and 1 hour tutorial

Objectives

- *To impart knowledge in the area of measurement principles*
- *To provide in depth understanding of operation, performance, and applications of important measuring instruments used in electronics laboratories*.

Module I (13 hours)

Generalized configurations of Instruments - Functional element, Analog and Digital modes, Null and deflection methods, Methods of correction. Static characteristics of instruments- Calibration accuracy, precision, bias, sensitivity, linearity, threshold, resolution, hysterisis and dead space. Measurement errors- various types. Measurement standards and calibration.

Dynamic characteristics - Modelling, digital stimulation methods to first and second order instruments for standard test signals-frequency response. Dead time elements. Response of an Instrument to periodic and transient inputs. Determination of measurement system parameters. Units, dimensions and standards. Digital instruments-basic blocks.

Module II (15 hours)

Signal generators - low frequency signal generators, function generator, pulse, RF signals, sweep generators, Frequency synthesizer, arbitrary waveform generator.

Analog to digital converters-Tracking, successive approximation, charge distribution, flash, subranging, and integrating type ADCs., Time base generators (Basic principle), Timer IC 555- Block diagram- Astable and monostable circuits using IC 555, PLL - basic principles , applications.

Module III (14 hours)

Digital to analog converters-weighted resistor, weighted capacitor, potentiometric, and R-2R ladder type DACs. BipolarDACs, Master-slave DACs. Performance specifications of ADCs and DACs. Cathode ray oscilloscope (review), Special purpose oscilloscopes-delayed time-base, analog storage, sampling oscilloscopes. Digital storage oscilloscopes - DSO applications.

Module IV (12 hours)

Graphic Recording Instruments: strip chart recorder, X-Y recorder, Plotter, liquid crystal display (LCD). Waveform analysing instruments: Distortion meter, Spectrum analyser, Digital spectrum analyser, Q meter, Watt-hour meter, Power-factor meter, Instrument transformers, Thermocouple instruments, Peak response voltmeter, True RMS meter.

Text Books

1. D. A. Bell, Electronic Instrumentation and Measurements, Prentice Hall of India, New Delhi
2. S. Franco, Design with Operational Amplifiers and Analog Integrated Circuits, Tata McGraw Hill, New Delhi (for ADCs and DACs only)
3. J. J. Carr, Elements of Electronic Instrumentation and Measurements, Pearson Education, Delhi
4. T. G. Beekwith, R. D. Marangoni, and J. H. Lienhard, Mechanical Measurements, 5lh ed., Pearson Education, 1993 .

Reference Books

1. E. O. Doebelin, Measurement Systems: Application and Design, 4th ed., McGraw-Hill, New York, 1990.
2. W. D. Cooper and Helfrick A. D, Electronic Instrumentation and Measurement Techniques, 4th ed., Prentice Hall of India, New Delhi, 1992.
3. J. P. Bentlev. Measurement Svstems. Pearson Education. Delhi. 2003

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 405: Linear Integrated Circuits

Teaching Scheme **Credit: 4**

3 hour lecture and 1 hour tutorial

Objectives

- *To expose the students to the principles of integrated circuit fabrication*
- *To provide in depth understanding of the fundamentals of Op-Amp and various circuits using Op-Amp.*

Module I (13 hours)

Integrated circuit-fabrication, Introduction to Operational amplifier: block diagram representation, analysis of a typical Op-Amp circuit, constant current bias, current mirror, the ideal Op-Amp, equivalent circuit of an Op-Amp, ideal voltage transfer curve, offset error voltages and currents, CMRR, PSRR. frequency Response of an Op-Amp (brief discussion): compensating networks, high frequency Op-Amp equivalent, open loop and closed loop frequency response, Slew rate, causes of slew rate, effect of slew rate in applications. 741 Op-amp-Simplified internal circuit.

Module II (14 hours)

Op-Amp with negative feedback-non In-verting and inverting amplifiers- I/P resistance with feedback, O/P resistance, band width, voltage follower, concept of virtual ground, I to V converter, differential amplifier with one Op-Amp, instrumentation amplifier, AC amplifiers with single supply voltage, summing, scaling and averaging amps, V to I converter with floating load, V to I converter with grounded load.

integrator, differentiator, comparator, zero crossing detector, timing mark generator, sample and hold circuit, Precision Diode, Precision rectifier, average detector, peak detector, logarithmic and antilog amplifiers, analog Multiplier.

Module III (14 hours)

Oscillators: principles, types, frequency stability, phase shift oscillator, Wien bridge oscillator. Astable, monostable, bistable multivibrators, triangular wave generator, saw tooth wave generator.

Active Filters: first order Butterworth low pass, high pass, band pass and band stop filters, second Order Butter worth low pass, high pass, band pass and band stop filters, all pass filter, universal active filters, switched capacitor filter-theory of operation, switched capacitor integrator.

Module IV (13 hours)

Voltage regulators-Voltage Regulators, Design of Series Voltage Regulator, Series regulator with Current Pre-regulator. Specialized ICs and applications: Voltage regulator ICs – 78XX and 79XX series- 317 variable regulators- 723 switching regulators- - LM 380 power amplifier - intercom using LM 380- 8038 Function generator chip applications

Text Books

1.R. Gayakwad, Op-Amps and Linear Integrated Circuits, Pearson Education, Delhi,

2.R. Coughlin and F. Driscoll, Operational Amplifiers and Linear Integrated Circuits, 6lh ed., Pearson Education, Delhi, 2003

3.D. R. Choudhury and S. Jain, Linear Integrated Circuits, New Age International, New Delhi, 2002.

4. D. A. Bell, Electronic Instrumentation and Measurements, Prentice Hall of India, New Delhi, 2003

Reference Books

1.S. Franco, Design with Operational Amplifiers and Analog Integrated Circuits, Tata Mc-Graw Hill, New Delhi, 2002

2.D. A. Bell, Operational Am,. Afiers and Linear Circuits, 4th ed., Prentice Hall of

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

Note: One of the assignments shall be simulation of OP-AMP circuits using any circuit simulation software.

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 406: Microprocessors and Interfacing

Teaching scheme **Credit 4**

3 hours lecture and 1 hour tutorial

Objectives

This course aims to equip the students with the basic knowledge of architecture, programming and interlacing of the microprocessors 8085 and 8086.

Module I (13 Hours)

Concepts of Microprocessors, microcomputers and assembly language, Microprocessor architecture,. Memory organization. Memory mapped I/O and I/O mapped I/O modes. I/O interfaces. The 8085 MPU: architecture, Buses and signals, Flags, Interrupts.

Module II (14 Hours)

Programming with 8085: instruction format, addressing modes. Basic Instructions, Logic operations, Branch operations, Data transfer, Counter and Timing delays, stacks and subroutines.
Intel 8086 processor, Architecture, Concept of memory segmentation, Addressing modes, Instruction set.

Module III (14 Hours)

8086 processor - Assembly language programming, Assembler directives and operators, Assembly process, Linking and relocation, stacks, procedures, interrupt routines, macros. Timing diagrams, 8086 hardware design - Bus structure, bus buffering and latching, system bus timing with diagram. Minimum and Maximum mode.

Module IV (13 hours)

Interfacing, Address decoding, interfacing chips: Programmable Peripheral Interface (8255), Programmable. Timer (8253/54), Programmable Interrupt Controller (8259), Programmable keyboard/display controller (8279), DMA and DMA controller (8237/57), ADC & DAC, Serial I/O and Data communication.

Text Books

1.R. S. Gaonkar, Microprocessor Architecture Programming and Application with 8085, Penram International Publishers, Bombay
2.D. V. Hall, Microprocessors and Interfacing: Programming and Hardware, Tata Graw Hill
3.B. Brey, The Intel Microprocessors, 8086/8088, 80186, 80286, 80386 and 80486 architecture,Programming and interfacing, Prentice Hall of India, New Delhi

Reference Books

1.P. K. Ghosh and P. R. Sridhar. 0000 to 8085 Introduction to Microprocessors for Engineers and Scientists, Prentice Hall of India, New Delhi
2.Y. C. Liu and G. A. Gibsen, Microcomputer system: The 8086/8088 family, Prentice Hall of India, New Delhi

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

Note: One of the assignments shall be a programming exercise of 8085/8086.

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 407(P): Electronic Circuits Lab

Teaching scheme **Credits 2**

3 hours practical per week

Objectives

- *To provide hands-on experience on design, testing, and analysis of various transistor circuits*
- *To provide hands-on experience on design, testing, and analysis of OP-Amp circuits.*
- *To provide training on simulation of transistor and OP-Amp circuits using any suitable software.*

(Any 12 experiments)

1) Measurement of important OP-Amp parameters such as CMRR, slew rate, open loop gain, input and output impedances, GBW product.
2) Op-Amp basic circuits – voltage follower, inverting and non-inverting amplifiers
3) Op-Amp basic circuits-zero crossing detectors, integrator and differentiator
4) Wienbridge oscillator with amplitude stabilization
5) Second order Low pass filter and high pass filter
6) Precision rectifier
7) Sample and hold circuit
8) Logarithmic and anti-logarithmic amplifiers
9) Voltage regulators: IC 723
10) Voltage regulators: 78XX and 79XX
11) Design of PLL for given lock and capture ranges, freq multiplication
12) Active band-pass filter
13) Active band-reject filter
14) SCR Characteristics
15) Data visualization, plotting, and storage for data acquisition using technical computing software such as MATLAB/Octave/Scilab.

Internal Continuous Assessment *(Maximum Marks-50)*

60%-Laboratory practical and record
30%- Test/s
10%- Regularity in the class

Semester-End Examination *(Maximum Marks-50)*

70% - Procedure, conducting experiment, results, tabulation, and inference
20% - Viva voce
10% - Fair record

BM09 408(P): Digital Electronics Lab

Teaching scheme **Credits:** 2
3 hours practical per week

Objectives

- *To provide hands-on experience on design, testing, and analysis of various digital circuits*
- *To provide training on simulation of digital circuits using any suitable Software.*

(Any 12 experiments)

1. Characteristics of TTL and CMOS gates.
2. Realization of logic circuits using TTL/CMOS (NAND / NOR) gates.
3. Arithmetic logic circuits like Half adder, Full adder, Half-subtractor, Full subtractor.
4. 4-bit adder/subtractor, BCD adder-7483 circuits.
5. Astable and Monostable multivibrators using TTL/CMOS gates
6. Realization of RS, T, D, JK and JK Master Slave flip-flops using gates.
7. Realisation of Shift Registers- ring counter, Johnson counter.
8. Up/down Counter - asynchronous
9. Up/down Counter - synchronous
10. Study of Counter ICs
11. Study of Monostable multivibrator IC-74123
12. Arbitrary Sequence generator
13. BCD to Decimal and BCD to 7-segment decoder and display
14. Multiplexers and Demultiplexers-Realisation of combinational Circuits
15. Simulation of Digital circuits- combinational and sequential circuits- using any technical software
    a) Adder / Subtractor circuits
    b) JK Master Slave flip-flops using gates
    c) Shift register
    d) UP/DOWN Counter
    e) Arbitrary Sequence Generator.
16. VHDL Implementation: 2 simple examples

Internal Continuous Assessment *(Maximum Marks-50)*

60%-Laboratory practical and record
30%- Test/s
10%- Regularity in the class

Semester-End Examination *(Maximum Marks-50)*

70% - Procedure, conducting experiment, results, tabulation, and inference
20% - Viva voce
10% - Fair record

End Semester Examination *(Maximum Marks-50)*

70% - Procedure, conducting experiment, results, tabulation, and inference
20% - Viva voce
10% - Fair record

FIFTH SEMESTER

BM09 501: Digital Signal Processing

Teaching scheme **Credits: 5**
4 hours lecture and 1 hour tutorial

Objectives
To cover the following topics of digital signal processing.

- *Discrete Fourier transform and fast Fourier transform*
- *Techniques of IIR and FIR digital filter design and various filter structures*
- *Finite word length effects in DSP*
- *Brief ideas about computer architectures for signal processing with emphasis on TMS320 series processor.*

Module 1 (20 hours)
Review of Discrete Fourier Series and Discrete-Time Fourier Transform - Frequency domain sampling and reconstruction of discrete time signals - The Discrete Fourier Transform - DFT as a linear transformation - relationship to other transforms -properties of DFT - frequency analysis of signals using DFT - Linear filtering methods based on DFT - convolution using overlap add and overlap save methods- Efficient computations of the DFT- Fast Fourier Transform algorithms – decimation in time-decimation in frequency-in place computation-direct computation, divide-and-conquer approach, radix-2, radix-4 and split radix algorithms - implementation of FFT algorithms - Applications of FFT

Module 11 (16 hours)
Structures for realization of discrete time systems - structures for FIR and IIR systems - signal flow graphs, direct-form, cascade-form, parallel form, frequency sampling, lattice and transposed structures-representation of numbers and errors due to rounding and truncation - Quantization of filter coefficients - round off effects in digital filters - limit cycle oscillations, scaling for overflow prevention.

Module III (20 hours)
Design of digital filters - general considerations - causality and its implications, characteristics of practical frequency selective filters - design of FIR filters - symmetric and anti-symmetric, linear phase-design of IIR filters from analog filters – Design of LPF, HPF, Band pass and band stop filters-Butterworth and Chebyshev filters – properties – design equations - using impulse invariance, bilinear transformation, matched-z transformation, characteristics of standard filters and their designs - Frequency transformations in the analog and digital domains.

Module IV (16 hours)
Computer architectures for signal processing - Harvard architecture, pipelining, multiplier-accumulator, special instructions for DSP, replication, on chip storage, extended parallelism- general purpose DSP Processors - implementation of DSP algorithms for various operations - special purpose DSP hardware - hardware digital filters and FFT processors - case study and overview of TMS320 series processor.

Text Books

1. J. G. Proakis and Manolakis, Digital Signal Processing: Principles, Algorithms, and Applications, Pearson Education, Delhi
2. E. C. Ifeachor, B. W. Jervis, Digital Signal Processing: A Practical Approach, Pearson Education, Delhi

Reference Books

1. V. OppenheimT and R- W- Schafer-T Discrete-time Signal Processing, 2nd ed., Pearson Education, Delhi, 1999.
2. S. K. Mitra, Digital Signal Processing: A Computer Based Approach, 2nd ed., Tata McGraw Hill, 2001.
3. B. Venkataramani and M. Bhaskar, Digital Signal Processors, Tata McGraw Hill, New Delhi, 2002.
4. R. Chassaing, Digital Signal Processing with C and the TMS320C30, Wiley, NY, 1992.

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

Note: One of the assignments shall be simulation of discrete-time systems using technical computing software.

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

Note: *More than 75% of the questions shall be analytical/problem oriented types.*

BM09 502: Medical Physics

Teaching scheme **Credits 4**

3 hours lecture and 1 hour tutorial

Objectives

To provide an understanding about

- *Bioelectric and Bio-magnetic signals*
- *Electrical properties of biological materials*
- *Applications of radioactivity and ultrasonics in biological field*
- *Various biological effects of electromagnetic radiations*

Module l (13 hours)

Cell membrane - Nernst equation, Resting membrance potential, action potential propagation of nerve impulses, monophasic and biophasic recordings, Principles of electrocardiography, electromyography& electroencephalography - Skin contact impedance - -Hodgkin Huxley model of squid gait axon membrances. Biomagnetism- Principles of Magnetocardiography and Magnetoencephalography

Module II (14 hours)

Introduction to electrical simulation - impedance & current distribution — dielectric properties of biological materials - skin impedance - total body impedance - impedances at high frequencies - high voltage & transient properties - patient safety -electrical shocks-burn -hazards - leakage currents - types & measurements. Electrical safety - Protection against shock, Burn & explosion hazards –role of Clinical Engineer to keep the Medical environment safe

Effect of hypothermia and hyperthermia. Production of ultra low and low temperature for medical use

Module III (14 hours)

Nuclear physics- introduction, radioactivity, units of radioactivity, the decay law, nuclear reactions, elementary particles. Interaction of photon radiation with matter - interaction of swift charged particles with matter, interaction of neutron with matter. Radiation detectors – function, properties, types. Radiation sources – particle accelerators, neutron production. Units of radiation, isotopes as Diagnostic and therapeutic tools. Radiation safety, regulation and Dose limitations.

Module IV (13 hours)

Ultrasonic wave motion, wave characteristics, intensity, and ultrasound properties in body (velocity, attenuation, reflection, refraction and absorption). Use of ultrasound in biological field. Biological effects of electromagnetic radiations & its applications in biology.

Regulatory and assessment agencies & standards for Clinical Engineering, BIS standards & ISO regulations for Medical environment. Ethics in Biomedical Engineering-beneficence, Nonmaleficence, Ethical issues associated with medical technology

Text Books

1. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Volume I &II, 2nd ed, CRC press IEEE Press, 2000.
2. Kuchel, Bio Chemistry, Schaum Series McGraw Hill
3. W.R.Hendee & E.R.Ritenour, Medical Imaging Physics (3rd eds), Mosbey Year-Book lnc, 1992.
4. K. Bethge . G. Kraft & P. Kreisler . G. Walter, Medical Applications of Nuclear Physics, Springer, 2004.
5. Ruch TC, Patton HD (eds.) (1982): Physiology and Biophysics, 20th ed., 1242 pp. W. B. Saunders, Philadelphia.

Reference Books

1. R. S. Khandpur, Handbook of Biomedical Instrumentation. New Delhi: Tata McGraw-Hill Publishing Company Ltd., 1994.
2. D. Cooney, Biomedical Engineering Principles: An Introduction to Fluid, Heat, and Mass Transport Processes (Biomedical engineering and instrumentation series), Marcel Decker Publications, 1976

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 503: Advanced Microprocessors and Microcontrollers

Teaching scheme **Credits: 4**

3 hours lecture and 1 hour tutorial

Objectives

- *To expose the students to the features of advanced microprocessors like 80386, and Pentium processor*
- *To introduce the architecture, programming, and interfacing of the microcontroller 805*
- *To provide a basic idea about PIC microcontroller and its architecture..*

Module I (13 hours)

Introduction to 80386 - Memory management unit - Descriptors, selectors, description tables and TSS - Real and protected mode - Memory paging - Pentium processor -Special features of the Pentium processor - Branch prediction logic -Superscalar architecture, microprocessors - state of the art.

Module II (13 hours)

8051 Microcontroller: Overview of 8051 family, architecture of 8051, Program counter, ROM space in 8051, data types and directives, flags and PSW register, register bank and stack, Addressing modes. Instruction set-.Arithmetic instructions JUMP, LOOP, CALL instructions, time delay generations.

Module III (14 Hours)

Assembly Language programming in 8051 (some simple programs), programs using arithmetic and logic instructions, single bit instructions and programs, Timer/counter programming 8051 serial communication programming, programming timer interrupts. Interfacing with 8255 PPI, Stepper motor, keyboard, DAC, external memory.

Module IV (14 Hours)

Introduction to the PIC microcontroller , Program memory, Microcontroller clock, Microcontroller system, Types of microcontroller, Microcontroller specification, Microcontroller inputs and output (I/O), Timing with the microcontroller, Programming the microcontroller- Entering data, PIC 16F8XX Flash Microcontroller, PIC 16F877 Instructions, Registers, Capture/Compare/ PWM (CCP) Modules in PIC 16F877, Universal Synchronous Asynchronous Receiver Transmitter (USART), Analog-to-Digital Converter (ADC), Light Emitting Diodes (LEDs), Push Buttons, Relays and Latch Connections and Interface issues. Simple Programming (Not in detail)

Text Books

1. D. V. Hall, Microprocessors and Interfacing: Programming and Hardware, 2nd ed., Tata McGraw Hill, 1999.
2. M. A. Mazidi and J. G. Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson Education, Delhi, 2004
3. D W Smith, PIC in Practice A project based approach,Elsevier,2007

Reference Books

1. B. Brey, The Intel Microprocessors, 8086/8088, 80186, 80286, 80386 and 80486 architecture, Programming and interfacing, 6th ed., Prentice Hall of India, New Delhi, 2003.
2. KK. J. Ayala, The 8051 Microcontroller Architecture, Programming And applications, Penram International Publishing, Bombay, 1996.
3. R. Kapadia, 8051 Microcontroller and Embedded Systems, Jaico Publishing House, Mumbai, 2005.
4. PIC Microcontroller Data Manual, (Microchip 2002)

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 504 Computer Organization and Architecture

Teaching scheme **Credits 4**

3 hours lecture and 1 hour tutorial

Module I (14 hours)

Basic Structure of Computer Hardware & Software - Functional units, Basic Operational Concepts, Bus Structures, Software, Performance, Historical Perspective. Addressing Methods and Machine program sequencing -Memory Locations, Addresses encoding of Information, Main Memory Operations, Instructions & Instruction Sequencing, Addressing Modes, Assembly Language, Basic Input Output Operations, Stacks and Queues, Subroutines.

The Processing Unit -Fundamental Concepts, Fetching a word from memory, Storing a word in memory, Register Transfers, Performing an arithmetic or logic operation, Register Gating and Timing of Data Transfers. Execution of a complete Instruction, Hardwired Control, Performance Consideration, Microprogrammed Control.

Module II (13 hours)

Input Output Organization-Accessing I/O Devices, Interrupts, Direct Memory Access, I/O Hardware, Standard I/O Interfaces. Computer peripherals-I/O Devices-Video Terminals, Communication with remote Terminal, Video Displays, Flat panel Displays, Graphic Input Devices and Printers. On- Line Storage-Magnetic-Disk Systems~ Magnetic -Tape Systems CD-ROM Systems. System Performance Considerations-Disk Access Considerations, Communication Line Considerations

Module III (14 hours)

The Memory - Basic concepts~ Semiconductor RAM memories, Read Only Memories, Speed, Size and Cost, Cache Memories, Performance Considerations, Virtual Memories, Memory Management Requirements.

Arithmetic-Number Representations, Addition of Positive Numbers~ Design of Fast Adders, Signed Addition and Subtraction, Arithmetic and branching Conditions, .Multiplication of Positive numbers, Signed - Operand Multiplication, Fast Multiplication, Integer Division, Floating Point Numbers and Operations.

Module IV (13 hours)

Introduction to parallel processing-Pipelining - An Overlapped parallelism-Parallelism in unipolar systems, Parallel Computer structures, Architectural classification schemes. Principles of pipelining & Vector processing-Principles of Linear pipelining, Classification of pipeline processors, General pipelines and reservation tables, interleaved memory Organizations, Instruction and Arithmetic pipelines, Principles of designing pipelined processors, Vector processing Requirements. Structures for array processors: SIMD Array processor, SIMD Interconnection networks. Parallel Processing Applications.

Text Books

1. V. C. Hamacher, Z. G. Vranesic, and S. G. Zaky, Computer Organization, McGraw-Hill, New York.
2. K. Hwang and F. A Briggs, Computer Architecture and Parallel Processing, McGraw-Hill, N.Y.

Reference Books

1. Y. C. Liu and G.A Gibson, Microcomputer system: The 8086/8088fmnily, 2nd ed., Prentice Hall of India, New Delhi, 1986.
2. D. A Patterson and J. L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, 3rd ed., Morgan Kaufmann Publishers, San Francisco, C.A

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 505: Biosensors and Transducers

Teaching scheme **Credits 4**
3 hours lecture and 1 hour tutorial

Objective
To familiarise the students with
•*various types of transducers used to measure the temperature, pressure, and flow within the body*
•*some special sensors having biomedical application*

Module I (13 hours)
Transducers: definition, classification of transducer, active and passive, primary and secondary, Study of biological sensors in the human body and their basic mechanism action. Organisation of human nervous system-neural mechanism, Chemoreceptors, sensors for smell, touching, sound, vision, and taste.

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Module II (14 hours)
Chemical biosensors: Electrochemical sensors, chemical fibrosensors, blood-gas monitoring, blood-glucose sensors. Transducers for the measurement of iron and dissolved gases, Reference electrodes-hydrogen electrodes, Silver- Silver Chloride electrode-Calomel electrodes, Measurement of PH-glass pH electrodes, Measurement of PO_2, PCO_2- Catheter type electrodes.

Module III (14 hours)
Variable inductive transducers-different types, LVDT-principle, construction, RVDT, Variable capacitance transducers, electromagnetic transducers, hall effect transducer, optoelectronic transducers, Temperature transducers-Thermocouple, compensation, RTD, thermistor. Srain gauges-principle-types, bellows, diaphragms, membranes, capsules, piezoelectric material- application, differential pressure transducers. Blood pressure measurement using sphygmomanometer.

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Module IV (13 hours)
Flow measurement techniques, head flow meters, positive displacement type, area flow meters, electromagnetic, ultrasonic blood flow meter. Density measurement, weight measurement,. humidity and moisture measurement-hair hygrometer. Electrodes for ECG, EMG, EEG-electrode potential, electrode impedance, surface electrodes, microelectrodes.

Text Books

1.D.L. Wise, Applied BiosensorsWj&osensor Butterworth Publishers, Boston, 1989.
2.R S C Cobbold, Transducers for Biomedical Instruments, Prentice Hall
3.R. S. Khandpur, Handbook of Biomedical Instrumentation. New Delhi: Tata McGraw-Hill, New Delhi, 1994.
4..D.Patranabis, principles of Industrial Instrumentation, 2nd ed., McGraw-Hill, NewDelhi

Reference Books

1.J. G. Webster (ed.), Medical Instrumentation: Application and Design, 3rd ed., John Wiley & Sons, New York, 1998
2.H. E. Thomas, Handbook of Biomedical Instrumentation and Measurement, Virginia: Reston Publishing Company.

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 506: Medical Instrumentation

Teaching scheme **Credits 3**
2 hours lecture and 1 hour tutorial

Objectives

- *To familiarise the students with the principle and applications various analytical and diagnostic instruments*
- *To expose the students to the diagnostic features of ECG, EEG and EMG.*

Module I (8 hours)
Analytical instruments used in clinical environment-Spectrometry-UV, visible and infrared spectrometers. Autoanalysers, flame photometers, principles and applications-densitometers, gas and liquid chromatograph, Electrophoresis, oximeters,

Module II (9 hours)
Cardiac output measurement-different techniques, pulmonary function tests- spirometry- parameters measured-Lung sounds-different types-importance, blood cell counters-methods, Coutler counters-automatic recognition and differential counting.
Audiometers, Drug delivery devices, Dialysis equipment, Heart lung machine (block diagram approach)

Module III (9 hours)
Electrical activity of the heart, effect of electric field on cardiac muscles and laws of stimulation. Arrhythmias-its detection, Amplification, measurement and displaying/recoding of ECG, Principle of Electromyography-detection and applications, diagnostic features of EMG, Measurement principles of electroencephalography-applications-diagnostic features of EEG. Electrogastrogram, electroneurography - electroretinography – electrooccu lography.

Module IV (10 hours)
Cardiac pacemakers regular and ectopic pace makers electrocardiogram, phonocardiography, ballistocardiography, External and internal pacemakers-programmable pacemakers - power sources-design of encapsulation of leads. Defibrillators-principle and comparison of output waveforms of different types of DC defibrillators-energy requirements-synchronous operation-defibrillator analysers, treatment for arrhythmia.

Text Books

1.R. S. Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill,New Delhi
2.H. Williard, L. L. Merrit, J. A. Dean, and F. A. Settle, Instrumental Methods of Analysis, CBS Publishers and Distributors, India, 1988.

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A:	*Short answer questions (one/two sentences)* All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.	*5 x 2 marks=10 marks*
PART B:	*Analytical/Problem solving questions* Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.	*4 x 5 marks=20 marks*
PART C:	*Descriptive/Analytical/Problem solving questions* Two questions from each module with choice to answer one question.	*4 x 10 marks=40 marks*

Maximum Total Marks: 70

BM09 507(P): Medical Electronics Lab

Teaching scheme **Credits 2**

3 hours lecture and 1 hour tutorial

Objectives

- *To provide experience on design, testing, and analysis of some electronic circuits having application in biomedical equipment*
- *To familiarise the students with the operation of a few transducers having biomedical applications*

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(Any 12 experiments)

1. Instrumentation amplifier
2. Measurement using LVDT
3. Measurement using Strain gauge
4. AD590 temperature sensor
5. Thermister/RTD
6. Pacemaker circuits /heart rate meter
7. FM telemetry
8. Respiration meter
9. Optocoupler - application circuit
10. Voltage to frequency converter
11. Frequency to voltage converter
12. Astable, monostable multivibrators using 555 IC
13. Astable, monostable multivibrators using 741 IC
14. Phase Locked Loop-Application
15. ECG Simulator

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Laboratory practical and record (40%), term-project (20%)
30% - Test/s
10% - Regularity in the class

Term-project: An electronic circuit (moderately simple) having practical application is to be developed and demonstrated by each batch of students. It shall be set-up on a PCB. A report having not more than 10 pages shall also be submitted.

Semester-End Examination *(Maximum Marks-50)*

70% - Procedure and tabulation form, Conducting experiment, results and inference
20% - Viva voce
10% - Fair record

Internal Continuous Assessment *(Maximum Marks-50)*

End Semester Examination *(Maximum Marks-50)*

70% - Procedure, conducting experiment, results, tabulation, and inference
20% - Viva voce
10% - Fair record

BM09 508(P): Microprocessors and Microcontrollers lab

Teaching scheme **Credits 2**

3 hours lecture and 1 hour tutorial

Objectives

To acquaint the students with the following skills

- *Assembly language programming based on the microprocessors 8085 and 8086*
- *Assembly language programming based on the microcontroller 8051*
- *Interfacingprogramsbasedon8085/8086and8051*
- *ALPs using TASM/NASM*

(Any 15 experiments covering all the six sections)

I. Assembly Language Programming Based on 8085 Kit

1.Programs based on Arithmetic and Logic instructions
2.Array- Largest of arrays
3.8 bit Multiplication
4.Programs involving subroutines, stacks

II. Assembly language programs based on 8086 Kit

5.Addition / Subtraction of 64 bit Numbers.
6.Sorting of an array
7.Program s with lookup table
8.Square root of a 32 bit number, Average of n numbers

III. Interfacing programs based on 8085/8086 Kit

9.ADC & DAC
10.Stepper motor (forward & backward motion) '
11.Hex key pad
12.Seven segment display
13.8251 US ART

IV. Assembly language programs based on 8051 Kit

14.Addition / Subtraction of 64 bit Nos.
15.Sorting of an array
16.Program s with lookup table
17.Square root of a 32 bit no, Average of n numbers

V. Interfacing programs based on 8051 Kit

18.ADC&DAC
19.Stepper motor (forward & backward motion)
20.Hex key pad
21.Seven segment display(clock timer)
22.8251 USART

VI. ALPs using TASM/NASM

23.Simple programs listed above with usage of all assembler directives

24.String display, changing graphics mode, array and string operations
25.Downloading the assembled programs to 8086 kit

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Laboratory practical and record
30% - Test/s
10% - Regularity in the class

Semester-End Examination *(Maximum Marks-50)*

70% - Procedure and tabulation form, Conducting experiment, results and inference
20% - Viva voce
10% - Fair record

SIXTH SEMESTER

BM09 601: Bio-Signal Processing Techniques and Applications

Teaching scheme **Credits 5**
4 hours lecture and 1 hour tutorial

Objectives
To make the students familiarized with
- *acquisition of biomedical signals*
- *algorithms used for processing of biomedical signals (ECG,EEG,EGG)*
- *Statistical methods of signal analysis*
- *methods of ECG data compression*
- *Introduction to wavelets*
- *Biological signal modeling and non linear biomedical techniques*
- *Biomedical signal processing with a technical computing software*

Module I (16 hours)
Introduction to biomedical signals, characteristics of biomedical signals, Estimation of noise in signals Bio signal acquisition: Signal Conversion: Conversion requirements for biomedical signals, Acquisition of biomedical signals like ECG, EMG, etc. Statistical signal processing and non linear signal processing: fuzzy logic and algorithms-basic introduction. Introduction to signal representation using numerical computation software.

Module II (20 hours)
Adaptive filters: Principle of noise canceller model, 50 Hz adaptive canceling using a sine wave model. FIR: Smoothing, Notch, Derivatives, window design. Signal Averaging: Basics of Signal Averaging as a digital filter, software and limitations of signal averaging.
Data reduction techniques: Turning point algorithm, AZTEC algorithm, CORTES, Fan algorithm, Huffman algorithm. ECG QRS Detection: Power spectrum of ECG filtering Techniques, Differentiation Techniques, matching techniques, QRS detection algorithm. ECG Analysis System: ECG interpretation- ST segment analyzer, portable arrhythmia monitor.

Module III (18 hours)
Introduction to Signal modeling: biophysical models in signal processing. ECG signal simulation, EEG signal model. Modeling nerve potential and myoelectric activity. Signal prediction using AR models. Spectral estimation of signals: spectrogram and periodogram. Stochastic modeling-Markov process. Time – Frequency representation of biomedical signals.-introduction to wavelet transform-concept, comparison with FT, advantages, Wigner Ville distribution. Wavelet analysis using computing software.

Module IV (18 hours)
Numerical Computation for biomedical signal processing:. Modeling of systems-biomedical examples. Signal plotting and statistics: mean, variance and standard deviation, ensemble averaging.

Signal correlation and covariance. Autocorrelation and cross-correlation, cross-correlation of EEG waves. Power spectrum calculation and heart rate variability of ECG.
Transfer function representation of systems .RC filtering of EEG signals. Artificial neural network-basic introduction, applications. Feed forward neural networks.

Text Books

1. A. Cohen, Biomedical Signal Processing, Vol. I & II, CRC Press, 2002.
2. Signals and Systems in Biomedical Engineering: Signal Processing and Physiological Systems Modeling (Topics in Biomedical Engineering, Suresh Devasahayam, Springer, 2000
3. M.Akay, Detection and estimation of biomedical signals, Academic Press, San Diego, 1996
4. John L Semmlow, Biosignal and Biomedical Image Processing: MATLAB-Based Applications, Dekker/CRC Press, 2004.
5. W. J, Tompkins, Biomedical Digital Signal Processing: C Language Examples and Laboratory Experiments for the IBM PC, Prentice Hall, NJ:USA, 1993
6. K. P. Soman and K. I. Ramachandran, Insight into Wavelets, Prentice Hall of India, New Delhi, 2004.

Reference Books

1. M. Akay, Biomedical Signal Processing, Academic Press, San Diego, 1994.
2. David T. Westwick, Robert E, Identification of Nonlinear Physiological Systems (IEEE Press Series on BiomedicalEngineering), Wiley-IEEE Press, 2003
3. J.G.Webster and W.J. Tompkins, Design of Micro Computer based Instrumentation, Prentice Hall. NJ:USA, 1981.
4. Rolf Weitkunat, Digital Biosignal Processing, Elsevier Science, 1991
5. Eugene N. Bruce, Biomedical Signal Processing and Signal Modeling, Wiley-Interscience; 1 edition, 2000
6. Metin Akay, Time Frequency and Wavelets in Biomedical Signal Processing (IEEE Press Series on Biomedical Engineering), Wiley-IEEE Press, 1997.
7. Gail Baura, System Theory and Practical Applications of Biomedical Signals, Wiley-IEEE Press. 2002
8. Suresh R. Devasahayam, Signals and System in Biomedical Engineering: Signal Processing and Physiological Systems Modelling (Topics in Biomedical Engineering International Book Series), Kluwer Academic/Plenum Publishers, 2000

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

One of the assignments shall be based on processing of biomedical signals using any computational software like MATLAB/Octave/Scilab/Mathematica.

University Examination Pattern

PART A:	*Short answer questions (one/two sentences)*	*5 x 2 marks=10 marks*
	All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.	
PART B:	*Analytical/Problem solving questions*	*4 x 5 marks=20 marks*
	Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.	
PART C:	*Descriptive/Analytical/Problem solving questions*	*4 x 10 marks=40 marks*
	Two questions from each module with choice to answer one question.	

Maximum Total Marks: 70

BM09 602: Engineering Economics and Principles of Management

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Section 1: Engineering Economics

Objective
Impart fundamental economic principles that can assist engineers to make more efficient and economical decisions.

Module1 (14 Hrs)
Economic reasoning, Circular Flow in an economy, Law of supply and demand, Economic efficiency. Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Private and Social cost, Opportunity cost. Functions of Money and commercial Banking. Inflation and deflation: concepts and regulatory measures. Economic Policy Reforms in India since 1991: Industrial policy, Foreign Trade policy, Monetary and fiscal policy, Impact on industry.

Module II (13 Hrs)
Value Analysis – Function, aims, procedure.–Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor-Uniform gradient series annual equivalent factor. Methods of project analysis (pay back, ARR, NPV, IRR and Benefit -Cost ratio) Break-even analysis-, Process planning.

Text books

1. Panneer Selvam, R, Engineering economics, Prentice Hall of India, New Delhi, 2002.
2. Wheeler R (Ed) Engineering economic analysis, Oxford University Press, 2004.

Internal Continuous Assessment *(Maximum Marks-15)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern – for Section 1

Note: Section 1 and Section 2 are to be answered in separate answer books

PART A:	*Short answer questions (one/two sentences)* All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.	*2 x 2 marks=4 marks* *1 x 1 mark = 1 mark*
PART B:	*Analytical/Problem solving questions* Candidates have to answer two questions out of three. There should be at least one question from each module and not more than two questions from any module.	*2 x 5 marks=10 marks*
PART C:	*Descriptive/Analytical/Problem solving questions* Two questions from each module with choice to answer one question.	*2 x 10 marks=20 marks*

Maximum Total Marks: 35

Section 2: Principles of Management

Objective

- *To provide knowledge on principles of management, decision making techniques, accounting principles and basic management streams*

Module I (13 hours)

Principles of management – Evolution of management theory and functions of management Organizational structure – Principle and types. Decision making – Strategic, tactical & operational decisions, decision making under certainty, risk & uncertainty and multistage decisions & decision tree Human resource management – Basic concepts of job analysis, job evaluation, merit rating, wages, incentives, recruitment, training and industrial relations

Module II (14 hours)

Financial management – Time value of money and comparison of alternative methods. Costing – Elements & components of cost, allocation of overheads, preparation of cost sheet, break even analysis. Basics of accounting – Principles of accounting, basic concepts of journal, ledger, trade, profit &loss account and balance sheet. Marketing management – Basic concepts of marketing environment, marketing mix, advertising and sales promotion. Project management – Phases, organisation, planning, estimating, planning using PERT & CPM

Reference Books

1. F. Mazda, *Engineering management*, Addison Wesley, Longman Ltd., 1998
2. Lucy C Morse and Daniel L Babcock, *Managing engineering and technology*, Pearson Prentice Hall
3. O. P. Khanna, *Industrial Engineering and Management*, Dhanpat Rai and Sons, Delhi, 2003.
4. P. Kotler, *Marketing Management: Analysis, Planning, Implementation and Control*, Prentice Hall, New Jersey, 2001
5. Venkata Ratnam C.S & Srivastva B.K, *Personnel Management and Human Resources*, Tata Mc-Graw Hill.
6. Prasanna Chandra, *Financial Management: Theory and Practice*, Tata McGraw Hill.
7. Bhattacharya A.K., *Principles and Practice of Cost Accounting*, Wheeler Publishing
8. Weist and Levy, *A Management guide to PERT and CPM*, Prantice Hall of India
9. Koontz H, O'Donnel C & Weihrich H, *Essentials of Management*, McGraw Hill.
10. Ramaswamy V.S & Namakumari S, *Marketing Management : Planning, Implementation and Control*, MacMillan

Internal Continuous Assessment *(Maximum Marks-15)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern – for Section 2

Note: Section 1 and Section 2 are to be answered in separate answer books

PART A: *Short answer questions (one/two sentences)* — *2 x 2 marks=4 marks*, *1 x 1 mark = 1 mark*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* — *2 x 5 marks=10 marks*

Candidates have to answer two questions out of three. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* — *2 x 10 marks=20 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 35

BM09 603: Medical Imaging Techniques

Teaching scheme **Credits 4**
3 hours lecture and 1 hour tutorial

Objective
To explain various medical imaging techniques such as

- *Ultra sound imaging.*
- *X-Ray imaging.*
- *Magnetic resonance imaging*
- *Microwave imaging, etc.*
- *Medical Image reconstruction techniques*

Module I (14 hours)
Ultrasound in medicine-production and propagation of ultrasound: sound waves; piezo-electric effect; continuous and pulsed - wave ultrasound; reflection, refraction, scattering, attenuation; characteristics of unfocussed and focussed beams, ultrasound equipment: structures of mechanical and electronic probes; probes for external and internal use; principles of 'A' - mode, 'B' mode and 'M' mode scanning; structure and operation of real-time scanners.
Principles of Doppler ultrasound: Doppler effect, Doppler shift frequency; types of Doppler signal output, principles of continuous and pulsed-wave Doppler; principles of colour Doppler.
Hazards and safety of ultrasound: potential hazards - heating and cavitation; biological effects; safe operation of equipment, quality assurance: image quality; quality assurance of equipment, use of test phantoms

Module II (13 hours)
Planar X –ray imaging, Instrumentation, Digital X –ray imaging,applications- fluoroscopy.
X-ray computed tomography-principles of sectional imaging-scanner configuration, data acquisition system, Image formation techniques, applications- CT angiography
Radioisotope imaging-rectilinear scanners, linear scanners, emission computed tomography , gamma camera ,SPECT, PET. Radiation-Hazards and safety

Module III (14 hours)
Magnetic resonance imaging-introduction, clinical benefits, contrast sensitivity, tissue sensitivity, spectral analysis.
History. Basic physical principles-Pulse sequences, image acquisition and reconstruction techniques-MRI instrumentation, Magnets, Gradient coils, Shim coils, Transmitter, Receiver, Specialised coils. Room design and sitting. Functional MRI, applications of MRI- MR Angiography

Module IV (13 hours)
Infrared imaging-principle, imaging systems, clinical thermography, Microwave imaging, concept of Fusion Imaging
Image reconstruction from projections - basics of projection - parallel beam and fan beam projection ,2D reconstruction techniques, Iteration-ART -method of generating projections , Fourier slice theorem - Back projection technique- filtered back projection algorithms - testing back projection algorithms

Text Books

1.A. Macovski, Medical Imaging systems, Prentice-Hall, Englewood Cliffs

2.S. Webb, The Physics of Medical Imaging, Institute of Physics Publishing, Bristol, UK.

3.Hendrick W, Hykes D and Starchman D, Ultrasound Physics & Instrumentation 3rd Ed,, Mosby Year Book, 1995

4.William R. Hendee and E.Russel Ritenour, Medical Imaging Physics, 3rd ed., Mosby Year Book, St. Louis, 1992.

Reference Book

Richard P. Feynman, Robert B. Leighton, Matthew Sands; Feynman lectures on physics, Vol 2 Narosa Pub., 1986.

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 604: Control Systems

Teaching scheme **Credits 4**
3 hours lecture and 1 hour tutorial

Objective

- *To make the students familiarized with the modelling of linear time invariant systems and their responses in time and frequency domain. State space techniques are also discussed.*

Module I (14 hours)
Open loop and closed loop systems-examples. Transfer function of linear systems-Modelling of physical systems- Mechanical- translational and rotational systems- Electrical networks- Thermal, hydraulic, and pneumatic systems-Analogous circuits. DC servomotor- Transfer function, AC servomotor, Potentiometer, Stepper motor, Block diagram reduction, Signal flow graphs - Mason's gain formula.

Module II (14 hours)
Time Domain analysis: Standard test signals, Transient and steady state response analysis of first and second order systems-Time response specifications, Steady state error constants-generalised error series. Stability-definition, Routh's stability criterion, Absolute and relative stability.
Root locus plots - Rules for construction -Stability analysis using root locus.

Module III (12 hours)
Frequency response analysis: Frequency domain response specifications-estimation for second order systems, Correlation between time and frequency response for second order systems, Bode plot-gain margin and phase margin, determination of transfer function using Bode plots.
Frequency response analysis: Polar plots - Nyquist stability criterion- Stability analysis.

Module IV (14 hours)
Introduction to compensation: lag, lead, lag-lead networks (design techniques not required).
State Variable Analysis: Concepts of state, state variables, state vector and state space -State model of continuous time systems -Transformation of state variable -Derivation of transfer function from state model -State variable from transfer function -companion forms-controllable canonical form -observable canonical form -Jordan canonical form -Diagonalization - State transition matrix -computation of state transition matrix by Laplace transform, Cayley-Hamilton theorem – Controllability and observability of a system (proof not required)

Text Books

1. K. Ogata, Modern Control Engineering, 4lh ed., Pearson Education, Delhi, 2002.
2. R. Dorf and R. Bishop, Modern Control Systems, 10th ed., Pearson Education, Delhi, 2004.
3. B. C. Kuo, and D.C. Hanselman, MATLAB Tools for Control System Analysis and Design, Prentice Hall, Englewood Cliffs, 1994.

Referen ce Books

1. B. C. Kuo, Automatic Control Systems, 7th ed., Prentice Hall of India, New Delhi, 1995.
2. K. Ogata, Designing Linear Control Systems with MATLAB, Prentice Hall, Englewood Cliffs. 1994.

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

Note: *More than 75% of the questions shall be analytical/problem oriented types.*

BM09 605: Biomedical Equipments and Biophotonics

Teaching scheme **Credits 3**

2 hours lecture and 1 hour tutorial

Objective: *To introduce the concepts of*

- *Applications of Laser Spectroscopy and Imaging to in-vivo Tissues Diagnosis*
- *Functional Optical Microscopy of Living Cells*
- *Clinically Compatible Optical Instrumentation and Analytical Methods*
- *Photonic crystals and other media like meta materials*
- *Various equipment used for therapeutic applications, Eg. Pace makers, Ventilators, Stimulators, Dialysis equipment, Heart lung machine, etc.*

Module I (9 hours)

Overview of light sources, detectors and optics, brief discussion of Laguerre-Gaussian and Bessel beams .Introduction to lasers: principle, classifications. Laser-Tissue Interaction: Introduction:- the eye, skin, and other tissue. Type of laser-tissue interaction -Photocoagulation, Photo thermal Ablation, Photochemical Ablation, Photo disruption, Photochemical Interaction, Pathology of laser reaction in skin - thermal effects, laser irradiation - Non thermal reactions of laser energy in tissue. Portable laser-induced lifetime fluorescence spectroscopy and imaging instruments Nonparametric numerical methods for fast analysis of time-resolved fluorescence data ,Studies of fiberoptic probe designs for spectroscopic investigation of tissues Fluorescence ,lifetime imaging microscopy (FLIM) techniques ,Optical MEMS for surgical microsystems ,Minimally invasive surgical systems

Module II (10 hours)

Biological microstructure, Light propagation in optically dilute samples (single scattering theories; use of angular distribution of scattered light and polarization for information on scatterers) Overview of light propagation models in turbid medium (Transport theories, Monte Carlo simulation) Measurement of tissue optic parameters: Experimental techniques .Representative applications of elastic scattering from turbid media

Cardiovascular diseases (diagnosis of unstable atherosclerotic plaques that lead to stroke and heart disease) ,Oncology - neurosurgery (intraoperative diagnosis of brain tumors margins) ,Tissue engineering (in-situ evaluation of osteogenic differentiation) ,Analysis of structural proteins in tissue .Laser application in Therapy and diagnosis- Dentistry,Opthalmology,Electrosurgery,Endoscopy and fibre optical laser systems, Gynaecolgy and neurosurgery.

Introduction, basics of optical Microscopy, Use of contrast agents, fluorescent probes, Confocal Microscopy, Multiphoton microscopy, Non-linear microscopy. Near-field optical microscopy,Advanced methods in Fluorescence microscopy (FRET, FRAP, FCS) Introduction to optical micromanipulation tools (Tweezers, Spanners and microbeams, discussion of optical trapping forces, force calibration and instrumentation)

Module III (9 hours)

Ventilators-different types- principles, different generators, inspiratory phase, different cycling mechanisms, expiratory phase, Study of a typical ventilatory system. Precautions in using ventilators. Infant incubators.

Steady state and time resolved fluorescence spectroscopy of biological systems: basics, instrumentation and applications in biomedical diagnosis

Raman Spectroscopy of biological samples: basics, instrumentation and applications in biomedical diagnosis. Lab on a chip (Basic ideas and implementation), Photonic crystals and crystal fibers, meta material applications.

Module IV (8 hours)

Electrical stimulators, nerve and muscle stimulators, ultrasonic stimulators. Long wave Diathermy, Short wave diathermy, Surgical diathermy - principle and design of systems, Lithotripsy-principle, application, Maintenance of homeostasis. foetal heart rate monitoring Patient monitoring systems.
Introduction to techniques for filtering out multiply scattered light
Optical coherence tomography (OCT) (Basic principle, instrumentations and applications). Diffuse optical tomography (Principles, instrumentation and applications),Optical instrumentation: microscope, grating spectrometer

Text Books

1. Mushin, W. M., Automatic Ventilation of the Lung, 3rd ed., Blackwell, 1980
2. K. S. Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill, New Delhi, 1997
3. W. J. Meredith & J B Massey, Fundamental Physics of Radiology, Wright, Bristol. 1993
4. Goldman, Biomedical Lasers, Springer Verlag
5. John D Joannopoulos et al.,Photonic crystals, molding the flow of light, New Jersey , Princeton,2008

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 L01: Power Electronics

Teaching scheme **Credits 4**

3 hours lecture and 1 hour tutorial

Module 1 (15 hours)

Applications of power electronics,power semiconductor devices,control characteristics of power devices,types of power electronic circuits Diode characteristics,reverse recovery characteristics,power diode types,series and parallel connected diodes,diodes with RC,RL,LC and RLC loads,Free wheeling diodes.Construction,rating and characteristics (including SOA rating) of power transistors,SCR,TRIAC,IGBT,GTO and MCT.

Thyristor characteristics,two transistor model of thyristor,thyristor turn on and turn off,types of thyristors,series and parallel connection of thyristors,di/dt and dv/dt protection,Thyristor commutation techniques: natural and forced commutation techniques.

Module 2 (13 hours)

Controlled rectifiers : single phase half wave rectifiers,performance parameters, single phase full wave rectifiers,multiphase star rectifiers,three phase bridge rectifiers

AC voltage controllers-Introduction, principle of ON-OFF and phase control, single phase bidirectional controllers with resistive and inductive loads.

Module 3 (13 hours)

DC choppers - principle of step down and step up operations - step down chopper with RL load, Classes of chopper, MOSFET/IGBT choppers,switching mode regulators,comparison of regulators.

DC to AC converters: Thyristor inverters, McMurray-McMurray Bedford inverter, current source inverter, voltage control waveform control, inverters using devices other than thyristors, vector control of induction motors

Module 4 (13 hours)

AC motor controllers: induction squirrel cage motor control-voltage control,V/F control.torque-speed characteristics,control of wound rotor motor,slip power recovery.

DC motor controllers : armature voltage control of separately exited DC shunt motor.IR compensation,field current contrl,torque-speed characteristics,microcontroller based control circuit for motor control,scalar vector control of induction motors.

Text Books

1. M. H. Rashid, Power Electronics: Circuits, Devices and Applications, 3rd ed., Pearson Education, Delhi, 2002.
2. N. Mohan, T. M. Underland, and W. P. Robbins, Power Electronics: Converter, Applications and Design, John Wiley & Sons, New York, 1995.

Reference Books

1. G. K. Dubey, S. R. Doradla, A. Joshi and R. M. K. Sinha, Thyristorised Power Controllers, New Age International Publishers, New Delhi, 1996.
2. P. S. Bimbhra, Power Electronics, Khanna Publishers, New Delhi
3. Joseph Vithyathi, Power Electronics, McGraw-Hill, USA, 1995

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 L02: Computer Networks

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objective

- *This course imparts some ideas on computer network concepts of TCP/IP, link layers, etc.*

Module I (14 hours)

Computer Networks and the Internet-The Network Edge. The Network Core. Network Access and Physical Media, ISPs and Internet Backbones. Delay and Loss in Packet-Switched Networks. Protocol Layers and Their Service Models. Application layer. Principles of Application Layer Protocols. The Web and HTTP. File Transfer FTP. Electronic Mail in the Internet. DNS-The Internet's Directory Service.

Module II (13 hours)

Transport Layer. Introduction and Transport-Layer Services. Multiplexing and Demultiplexing Connectionless Transport UDP. Principles of Reliable Data Transfer. Connection-Oriented Transport: TCP- Principles of Congestion Control. TCP Congestion Control.

Module III (13 hours)

Networking Layer & Routing. Introduction and Network Service Model Routing Principles. Hierarchical Routing. The Internet Protocol. Routing and the Internet. Router architecture .IPv6. Multicast Routing. Mobility and the Network Layer.

Module IV (14 hours)

Link Layer. Data Link Layer: Introduction and Services. Error Detection and Correction Techniques. Multiple. Access Protocols. LAN Addresses and ARP. Hubs, Bridges and Switches. Wireless Links. PPP: The Point-to-Point Protocol. Asynchronous Transfer Mode (ATM). Wireless & Mobility (in brief). Security-Principles of Cryptography. Authentication . Integrity. Key Distribution. Access Control, Firewalls.

Text Book

1. J. Kurose and K. Ross, Computer Networking: A Top-Down Approach Featuring the Internet, Pearson Education, Delhi.

Reference Books

1.S. Keshav, An Engineering Approach to Computer Networking: ATM Networks, the Internet, and the Telephone Network, Pearson Education, Delhi, 1997

2.W. Stallings Computer Networking with Internet Protocol, Pearson Education, Delhi, 2003.

3.D. Comer, Computer Networks and Internets with Internet Applications, Pearson Education, Delhi

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 L03: Applications of Lasers in Medicine

Teaching scheme **Credits 4**

3 hours lecture and 1 hour tutorial

Objective

To introduce following topics to the students

- *Different types of lasers*
- *Interaction of the laser with the body tissue*
- *Laser instrumentation, optical components and positioning*
- *Medical applications of lasers*
- *Fundamentals and medical applications of fibre optics*

Module I (14 hours)

Introduction to lasers: Laser physics:-Introduction, Principle components of laser system, characteristics of laser light and. basic terminology, Mode of emission. Types of lasers- Solid state lasers, Gas lasers and Dye lasers, Lasers used in medical practice- Ruby laser, CO2 laser, Nd: Y AG laser and related solid state laser. He-Ne Laser (Aiming).

Module II (13 hours)

Laser-Tissue Interaction: Introduction:- the eye, skin, and other tissue. Type of laser-tissue interaction -Photocoagulation, Photo thermal Ablation, Photochemical Ablation, Photo disruption, Photochemical Interaction, Pathology of laser reaction in skin - thermal effects, laser irradiation - Non thermal reactions of laser energy in tissue.

Laser application in medical practice: Introduction, Lasers in surgery, Laser eye instrumentation: PRK and LASIK,Retinal disorders-gas laser (Argon, He-Ne)-Glaucoma (Nd:YAG), Lasers in Gynaecology: (Carbon dioxide) - Application safety with biomedical Lasers Introduction to endoscopes: cytoscopes, laproscopes, Fiber optic endoscopes and endoscope with integral TV cameras (Video Endoscopes).

Module III (13 hours)

Free and forced vibration of single degree of freedom systems; effect of damping; vibration isolation; resonance, Acoustic optical tables and optical bases-Need for vibration isolation- vibration measurement and instrumentation-tuning fork –accelerometer-honey comb table. Optical hardware-XYZ positioners- Goniometers –Mirrror lens and prism holders-Differential micrometers ,drive rack and rotation stages.

Module IV (14 hours)

Optical components for precision laser system for positioning and alignment –dispersion ,dielectric, laser line ,gold flat and aluminum mirrors, femtosecond and high power lasers, Beam splitters and lenses(CCD lenses). Absorptive ,reflective and variable reflective and neutral density ,mounded and unmounted filters, diffusers, dichroic filters ,cold mirrors .interference filters, polarisers, wave plates, multi-element optics ,focusing and objectivve lenses ,

IR,UV and visible achromats, laser beam expanders, right angle ,cube, dispersive ,dove, broca and penta prisms.

Optical windows, flats ,parallels, substrates and motion control systems for laser systems

Text Books

1.G. David Baxter, Therapeutic lasers - Theory and practice, Churchill Livingstone Publications, UK, 1997
2.David H. Shiney, Stephen, L. Trokel, Medical Lasers and Their safe use, Springer-Verlag publications
3.S. L. Wymer, Elements of Fiber optics, Regents-Prentice Hall publications, 1993.

Reference Books

1.Abraham Katzir, Laser and optical fibers in medicine, Academic press publications, 1993
2.Vij, D. R.; Mahesh, K. (Eds.), Medical Applications of Lasers, Springer- Verlag, 2002.
3.A. M. Cherin, An introduction to optical fibers, Mc Graw Hill publications, 1983
4.G. Reiser, Optical fiber communications, Mc Graw Hill, Third Edition, 2000
5.Greory T. Absten, Lasers in Medicine: An Introductory Guide, Kluwer Academic Publishers; 2nd edition, 1989.
6.Sigma Koki manual -2006 and opto-mechanics & manual positioners, optical coating products and motion control application systems for precision laser system for positioning and alignment

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 L04: Digital Systems Design

Teaching scheme **Credits 4**

3 hours lecture and 1 hour tutorial

Objective

- *To familiarize the students with the aspects of digital design using VHDL, Verilog, concepts of FPGA and the design using FPGA..*

Module I (15 Hours)

Introduction to VHDL Entities and Architectures,, Configurations, identifiers, data objects, Data types, and operators in VHDL. Entity declaration. Architecture modeling - structural, behavioral & data flow. Constant, signal, aliases, and variable assignments. Conditional statements - if ..then ..else, when...else, with select, and case statements. Loop statements - for, while, loop, and generate statements, exit, next, block, assertion, and report statements. Generics. Configurations - specification declaration, default rules, conversion functions, instantiation.

Module II (13 hours)

VHDL representation of combinational building blocks: Three state buffers, decoders, Multiplexers, Priority encoder, Adders, parity checker, VHDL representation of sequential circuit blocks:-latches. Flip flops, Registers, Counters, Memory, sequential multiplier, BCD to cxcess-3 converter, Implementation of combinational systems with ROM's and PLA's

Module III (13 hours)

Introduction to Verilog, Modules, Data types, Operators, Control Statements- If Else, Case, While, For Loop, Repeat etc, Variable assignments, Always Blocks, Tasks and functions, Concept of Test bench. State Machines design using Verilog.

Module IV (13 hours)

Design with FPGA: Concept of FPGA, Xilinx 4000 series as an example (Block diagram treatment only), Building application IC using FPGA, Introduction to simulation/synthesis software (Example ModelSim, Open Source GHDL etc) CPLDs. Altera 1 OK series as example. Testing: Scan testing, boundary scan testing, Built-in self test.

Text Books

1. M. Zwolinski, Digital System Design with VHDL, 2nd ed., Pearson Education, Delhi, 2004
2. C. H. Roth Jr., Digital Systems Design Using VHDL, PWS Publishing Co., Boston, MA, 1998
3. J. Bhaskar, VHDL Primer, Pearson Education, Delhi, 2004.

Reference Books

1. S. Yalamanchili, Introductory VHDL From Simulation to Synthesis, Pearson Education, Delhi, 2004
2. Z.Navab'i, VHDL; Analysis and Modeling of Digital Systems, 2nd ed., Tata McGraw-Hill, New Delhi, 1998
3. D. Perry, VHDL Programming by Example, 4th ed., Tata McGraw Hill, New Delhi, 2002

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 L05: Hospital Engineering and Management

Teaching scheme **Credits 4**

3 hours lecture and 1 hour tutorial

Objective

- *To make the students aware of the role and responsibilities of biomedical engineer in hospitals, especially in the management of medical equipments, management of electrical supply, maintenance of electrical safety, etc.*

Module I (13 hours)

Hospital various departmental planning &. design. BME services in hospitals; Role & responsibilities. Biomedical equipment procurement procedure - purchase & contract procedures, selection testing calibration and installation, Training to medical staffs - operating instructions.

Module II (14 hours)

Management of medical equipments, Planned preventive maintainance system, preventive maintenance & repair. Requirements of inter departmental computerization. DBMS in hospital, computerized medical record evaluation, Database approach to labarotary computerization, Case study on a hospital DBMS.

Module III (14 hours)

Hospital electrical supply & power systems-Hospital electrical systems, general power & lighting systems, Hospital wiring systems. Electrical safety, isolated power supply, line isolation monitor, performance testing of isolated power supply, I PS in patient care areas. Generator sets, UPS & voltage stabilizers. Causes of fail lures of electrical supply & ways to minimize them.

Module IV (13 hours)

Basics of Air conditioning and refrigeration. Air changes filtering & sterility. Hospital gas supply systems-centralized supply of air, oxygen nitrous oxide & vacuum. Theatre lighting, operating tables, wheel chairs & stretchers design.

Text Books

1. B.M.Sakharkar, Principles of Hospital administration & planning, Medical Publisher (?) Ltd, New Delhi, 1998.
2. J.G. Webster & Albert M.Cook, Clinical engineering principles & practices, Prentice Hall, 1979.
3. Barry. N. Feinberg, Applied clinical engineering, Prentice hall, 1986.
4. J. D. Bronzino, Handbook of Biomedical Engineering Vol. l & II, C RC Press, 2000.
5. Yadin David, et a1; Clinical Engineering (Principles and Applications in Engineering), CRC Press, 2003.

Reference Books

1. Jacob Kline ed., Hand book of Biomedical Engineering, Academic press, 1988
2. Anantha Narayanan, Basic refrigeration & air conditioning, Tata Mc Graw Hill, Second edition.
3. Yashpal Sharma, Hospital & Medical Gases Management, Bharat Book Centre,

Lucknow, 2001 Hem Chandra, Hospital Equipment Management, Bharat Book Centre, Luknow.

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 607(P): Biomedical and Clinical Instrumentation Lab

Teaching scheme **Credits 2**

3 hours practical per week

Objective

- *This course is intended for acquainting the students with operation and working principles of various biomedical instruments, surgical procedures and clinical instrumentation.*

(Any 10 experiments)

1) Power amplifier and Chart Drive circuit
2) QRS Detector
3) Study and servicing Electrosurgical unit
4) Automatic gain compensation circuit and Time gain compensation circuit
5) Practical study of medical symbol , medical safety, equipment grounding and wiring procedures for hospitals and healthcare
6) Study of electrodes and data acquisition of bio-signals
7) Data acquisition EMG and classification for myopathic and neuropathies diseases
8) EEG data acquisition and classification of brain disorders & EP response studies.
9) With the help of a flow cytometer /haemato cytometer,sort the different cells in blood
10) Use of live cell imaging microscope for observing cell organelles by staining methods, service of light microscope for cell imaging
11) Use of electrophoretic method to deposit hyroxylapatite on an electrode/ bone like extracellular matrix
12) Study and calibration of Spectrophotometer, Calorimeter
13) Flame photometer-Study, Standardisation & Calibration
14) Study & familiarization of Laser Equipment for therapy and as a light source for imaging
15) Servicing of ECG equipment.
16) Study of multiparameter physiological recorders.
17) Study of solid-state cautery.
18) Study of ventilator and X-ray Radiography system (Demo)
19) Study and measurement of tissue anisotropy
20) Study of Ultrasound devices –Ultrasound Transmitter, Ultra Sound Detector (Demo)
21) Measurement of flow velocity and rheological properties of a bio fluid using Doppler ultrasound

There shall be a hospital training of minimum 10 hours duration as part of this laboratory subject to familiarize with various biomedical equipment. Each student has to submit a report based on the hospital training.

Internal Continuous Assessment *(Maximum Marks-50)*

60%-Laboratory practical and record (40% weightage for laboratory performance and 20% for hospital training)
30%- Test/s (25% weightage for laboratory performance and 5% for hospital training)
10%- Regularity in the class

Semester-End Examination *(Maximum Marks-50)*

70% - Procedure and tabulation form, Conducting experiment, results and inference
20% - Viva voce
10% - Fair record

BM09 608(P): Mini Project

Teaching scheme **Credits:** 2
3 hours practical per week

Objectives

- *To estimate the ability of the student in transforming the theoretical knowledge studied so far into a working model of a biomedical/electronics/instrumentation system.*
- *For enabling the students to gain experience in organisation and implementation of a small project and thus acquire the necessary confidence to carry out main project in the final year.*

In this practical course, each group consisting of three/four members is expected to design and develop a moderately complex biomedical/electronics/instrumentation system with practical applications; this should be a working model. The basic concepts of product design may be taken into consideration while designing the project. A committee consisting of minimum three faculty members specialised in biomedical/electronics/instrumentation engineering will perform assessment of the mini project. Students have to submit a report on the mini project and demonstrate the mini project before the evaluation committee.

60% of the total marks to be awarded by the guide/Co-ordinator and the remaining 40% by the evaluation committee.

Internal Continuous Assessment *(50 marks)*
40% - Design and development
30% - Final result and Demonstration
20% - Report
10% - Regularity in the class

Semester-End Examination *(Maximum Marks-50)*

20% - Demonstration of mini project
50% - Practical test connected with mini project
20% - Viva voce
10% - Report

SEVENTH SEMESTER

BM09 701: Digital Image Processing

Teaching scheme **Credits 5**
4 hours lecture and 1 hour tutorial

Objectives

- *To provide elementary knowledge about digital image processing.*
- *To discuss various image transforms used in digital image processing.*
- *To explain the algorithms adopted for image enhancement and image restoration*

Module I (18 hours)
Digital Image Concepts-Analog & Digital Images, Digital Image definition, Digital Image Processing, Steps in DIP, Components of Digital Image Processing System- Elements of Visual Perception, Image Sensing & Acquisition, Image Formation model, Image sampling and Quantization, Basic relationship between Pixels-Image Transforms- 2D DFT, FFT, Walsh, Hadamard, Haar, DCT, KL, Wavelet transforms and its properties.

Module II (18 hours)
Image Enhancement-Point Processing-Gray Level-Piece wise-Linear, Histogram- Equalization-Specification, Arithmetic and Logic Operations-Enhancement in Spatial Domain-Mask Operation, Low Pass-High Pass filters-Enhancement in Frequency Domain-Basic steps, Low Pass-High Pass-Homomorphic techniques

Module III (18 hours)
Image Restoration-Image Degradation/Restoration model, Spatial and Frequency Domain filtering, Inverse-Wiener-Constrained, Least Square-Geometric mean filters. Singular Value Decomposition-Colour Image Processing-Fundamentals-Colour models- ROB, CMY, HIS-Pseudo Colorings, , Airy function in imaging ,Modulation transfer function ,Point spread function and laser speckle imaging

Module IV (18 hours)
Image Compression-Fundamentals-Redundancy~Infonnation measurement compression model-Lossless compression-Variable Length, LZW, Bit-plane coding, Loss less predictive- Lossy compression- Lossy predictive, Transform coding-Fundamentals of JPEG and MPEG, Wavelet Compression Image Segmentation-Details of Discontinuities, Edge linking and Boundary detection, Thresholding, Region based segmentation. Object Recognition-Basic concepts of Pattern and Pattern Classes, Pattern Matching, facial recognition algorithms. Pattern recognition and Neural Networks.

Text Books

1. R. Gonzalez and R. E. Woods, Digital Image Processing, Pearson Education, Delhi
2. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall of India, New Delhi

Reference Books

1. A. Rosenfeld and A. C. Kak, Digital Picture Processing, 2nd ed., Academic Press, New York, 1997.
2. W. K. Pratt, Digital Image Processing, 3rd ed., John Wiley & Sons, New York, 2001.
3. Andrews A. C and Hunt B. R., Digital Image Restoration, Prentice Hall, New Jersey, 1997

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 702: Fundamentals of Bioacoustics

Teaching scheme **Credits 4**

3 hours lecture and 1 hour tutorial

Objectives

- *To introduce the fundamentals of sound propagation, relationship to animal behavior and communication, and propagation of sound in media. Animal bioacoustics and interaction with environment, physiology of hearing and speech, representation of sound using wave equation, active control of sound and vibration, computational acoustics, sensors and techniques of sound recording and analysis, SONAR , noise and underwater acoustics in marine biology, acoustic ecology and soundscapes of Insect, Fish, Amphibians, Mammals, Birds, etc. are also covered in this subject.*

Module I (14 hours)

Fundamentals of sound, motion of a simple pendulum, simple harmonic motion, The Nature of a Sound Wave: Sound as Mechanical Wave , Longitudinal Wave ,Pressure Wave, Sound Properties and Their Perception, Pitch and Frequency ,Intensity and the Decibel Scale, Speed of Sound, sound propagation. Behavior of Sound Waves: Interference and Beats, Doppler Effect and Shock Waves , Boundary Behavior , Reflection, Refraction, and Diffraction

Resonance and Standing Waves: Natural Frequency, forced Vibration, standing Wave Patterns , fundamental Frequency and Harmonics.

Acoustics and noise,_Sound pressure level, acoustic impedance, Divisions of acoustics: physical acoustics, biological acoustics and acoustical engineering. Psychoacoustics, Acoustics & Signal Statistics, Mathematics of Vibrations, wave equations. Basic molecular model –particle velocity. Temperature and pressure are related to the molecular velocity statistics. Basic Differential Equations., Acoustic Equations. :one dimensional wave equation,

Module II (13 hours)

The auditory system, Anatomy and physiology of sound in the human body, lung sounds, heart sounds, the vocal system of speech and speech production –anatomy and physiology

Open-End Air Columns ,Closed-End Air Columns, sound reverberation ,sound reproduction

Sound based measurement- units of measurement: Decibel, sone, mel, phon, hertz

Plane Waves., Coupling Power out of a Plane Wave. Spherical waves, plane and spherical wave spectra. Sound Waveguide and Cavity Modes Auditorium acoustics, projection of sound, sound proofing, sound clarity, bass traps and echoes, architecture of the enclosure and sound reinforcement, Active control of sound and vibration: Acoustic propagation in ducts, minimization of radiation using source coupling, sound field control in enclosures, vibration control of lumped element and distributed parameters

Acoustics in Fluid Media - Wave propagation in stationary and moving fluids; acoustic radiation and scattering; standing waves in ducts and cavities. Sound Speed Variation in the ocean with variation in temperature, depth, salinity; Geographic Variation; Acoustic bottom and surface losses; absorption losses; Typical propagation modes; surface layer; shallow channels; deep channels; convergence zones; RAP; Typical Propagation Curves

Module III (13 hours)

Electroacoustic Transducers - The theory, design, and calibration of passive, linear, reciprocal electroacoustic transducers for use in both air and water media. Ultrasound applications in the human body –therapy and imaging

Sound sensors, piezoelectric crystals, accelerometers ,speakers and Dolby 3D surround sound, microphone, loudspeakers, sound baffle, SAW sensors, vibration measurement, spectral analysis of sound, hearing aids, sonobuoys, hydrophones, speakers, with woofers and tweeters , SONAR systems, speech processing, digital signal processing using sound, sound spectrogram. Examples of muffler acoustics, Helmholtz resonator, pneumatic filters- Acoustic High-Pass, Low-Pass, and Band-Stop Filters, microphone design.

Underwater Sound Propagation - Theoretical and empirical treatment of sound propagation in the ocean, including effects of the environment, characteristics of targets, and transducers.. Sonar Engineering - Theoretical and empirical treatment of problems related to the use of underwater sound in target detection and ranging, sound localization

Sources of noise; shipping; wind generated; thermal; others; Noise spectra; ambient noise angular distribution and correlation properties; use of the spatial correlation function in system calculations.

Module IV (14 hours)

What is Bioacoustics **,** Sound production in animals, including anatomy and neurophysiological processes **,**Animal Communication & Conservation**,** Marine Mammals Visual and Acoustic Surveys, Bioacoustics, Acoustic Ecology and Soundscapes ,Insects ,Fish ,Amphibians ,Mammals ,Birds

Vibrational communication of insects, Biosonar or echolocation of bats and dolphins, Ultrasonic signals (>20,000 Hz) of insects, rodents, bats and dolphins ,Infrasonic signals (<20 Hz) of large mammals ,Sound reception capabilities and mechanisms of animal hearing ,

Ethology of animal acoustic communication ,Evolution, ontogeny and development of acoustic behaviour ,Relationships between animal sounds and their environment ,

Effects of man-made sounds on animals ,Application of acoustic signals for taxonomic studies and for calibrating biodiversity ,Practical bioacoustic applications, in wildlife monitoring and in pest control , Acoustic monitoring of threatened and endangered species in inaccessible areas, Song Sparrow acoustic interactions, Northern right whales, Finback whale behavior ,Acoustic census of migrating bowhead whales, The use of pop-up ocean-bottom hydrophones to record whales, Effects of human-made sounds on the behavior of whales

Radio tagging and monitoring, Data & Sound Analysis Tools**,** Recording & Monitoring Tools**,** Sound detection and recording, Sound pollution

Computational Acoustics - Introduction to the computational techniques available for solving acoustics problems. Symbolic manipulation, finite differences, propagation methods, finite methods, boundary elements, grid generation, and scientific visualization

.

Textbook

1. Lawrence E. Kinsler, Austin R. Frey, Alan B. Coppens, James V.Sanders , Fundamentals of Acoustics .
2. Au, Whitlow W.L., Hastings, Mardi C., Principles of Marine Bioacoustics, Series: Modern Acoustics and Signal Processing
3. Robert D. Finch ,Introduction to Acoustics
4. William S. Burdic, Underwater Acoustic System Analysis
5. Paul C. Etter, Underwater Acoustics Modelling and Simulation: Principles, Techniques and Applications
6. Richard O. Nielsen ,Sonar Signal Processing
7. Charles H. Sherman, John L. Butler, Transducers and Arrays for Underwater Sound (Underwater Acoustics

References

1. Claybourne, Anna ,Sound,Edition: 2007
2. Berg, Richard E. and Stork, David G., The Physics of Sound
3. Frank J. Fahy, Foundations of Engineering Acoustics
4. F. Alton Everest, Master Handbook of Acoustics
5. Robert J. Urick, Principles of Underwater Sound 3rd Edition
6. D. Waite, Sonar for Practicing Engineers
7. Xavier Lurton, An Introduction to Underwater Acoustics
8. Mitch Gallagher, Acoustic Design for the Home Studio
9. Bob Katz, Mastering Audio, Second Edition: The art and the science
10. Jeff Cooper, Building a Recording Studio
11. Roey Izhaki, Mixing Audio: Concepts, Practices and Tools

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 703: Biomaterials

Teaching scheme **Credits 3**

2 hours lecture and 1 hour tutorial

Objective

- *This course gives information on the nature of the materials to be used for Implantation, different structures of solids, biocompatibility of certain materials, etc.*

Module I (9 hours)

Definition and classification of biomaterials: application of polymers, metals, ceramics and composite as biomaterials for implantation. Surface properties of materials, physical properties of materials-mechanical properties, viscoelasticity. Metallic implant materials: stainless steel, co-based alloys, Ti and Ti based alloys, ceramic implant materials: aluminium oxides, glass ceramics, carbons, hard tissue replacement implant: Orthopaedic implants, dental implants. Soft tissue replacement implants: Percutaneous and skin implants, vascular implants, heart valve implant.

Module II (9 hours)

Polymeric implant materials: Polyolefins, Polyamides, acrylic polymers, fluro carbon polymers, rubbers, thermoplastics. Physiochemical characteristics of biopolymers, biodegradable polymers for medical purposes. Synthetic polymeric membranes and their biological applications. Biopolymers in controlled release systems. Artificial skin. Dialysis membrane

Module III (9 hours)

Structure of solids: crystal structure of solids-crystal imperfunctions- noncrystalline solids. Strength of biomaterials: Strength and strengthening mechanisms of metals, ceramics, glasses' and polymers. Structural properties of tissues-Bone, Teeth, plastic tissues.

Module IV (9 hours)

Biocompatibilty: definition, wound healing process-bone healing, tendon healing. Material response: function degradation of materials in vivo. Host response-tissue response to biomaterials, Testing of implants: Methods of test for biological performance-In vitro implant tests, Qualification of implant materials

Text Books

1. J. B. Park & R. S. Lakes: Biomaterials: An Introduction, Plenum Press, New York,1992
2. Donald L. Wise [et a!.] eds: Encyclopedic handbook of biomaterials and bioengineering (4 vols.). Marcel Dekker, New York, 1995
3. F. H.Silver, Biomaterials, Medical Devices & Tissue Engineering: An integrated approach. Chapman & Hall, 1994
4. Sujata V. Bhat, Biomaterials, Narosa Publishing House, 2002.

Reference Book

1. B.D. Ratner, A.S. Hoffman, F.J. Schoen, and J.E. Lemons (Eds.), Biomaterials Science: An Introduction to Materials in Medicine, Academic Press, San Diego, 1996.

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 704: Biomechanics

Teaching scheme **Credits: 3**

2 hours lecture and 1 hour tutorial

Objectives

- *To impart knowledge on the structure of body parts like bones and their mechanical properties*

Module I (9 hours)

Structure and composition of bone, bone types, response to stress, common bone injuries and diseases, Crack propagation, fracture fixation devices, cartilages, ligaments and tendons, structure of spine, osteoporosis, arthritis.

Module II (8 hours)

Statics and dynamics of biomechanics, musculoskeletal model, wolff's law, projectiles, torque studies, joint movements, power, work and energy, Angular and linear motion, centre of gravity, gait analysis.

Module III (10 hours)

Stresses related to total hip prosthesis, Maxwell's and voight's model, force velocity relationship, Biomechanics associated with lifting, foot pressure measurements, Work related biomechanics, internal stresses associated with joints, isometric, isokinetic and isotonic muscle contractions.

Module IV (9 hours)

Scoliosis, methods to correct scoliosis, tonometer, Exoskeletal system, Powered wheelchairs, crutches and canes, bone densitometry.

Text Books

1. Alexander R Me Ncill Biomechanics, Chapman and Hall, 1975.
2. D. N. Ghista, Biomechanics of Medical Devices, Macel Dekker, 1982.
3. Susan J. Hall, Basic Biomechanics, Me Graw Hill, Columbus - OH, 4th Edition, 2003.
4. Benno M. Nigg, Walter Herzog (editors), Biomechanics of the musculo-skeletal system. John Wiley and Sons, NY, Second edition, 1999.

Reference Books

1. Arthur .T.Johnson, Biomechanics & Exercise Physiology, John Wiley and Sons, NY, 1991.
2. Y.C. Fung, Biomechanics: mechanical properties of living tissues. Second edition. Springer-Verlag, 1993.
3. VC Mow and W C Hayes, Basic Orthopaedic Biomechanics, Lippincott - Raven Publishers, Pennsylvania (USA), 2nd Edition, 1997.
4. D. Dowson & V.Wright, Introduction To Biomechanics of Joints and Joints Replacement. Mechanical Engineering Publication Limited, London, 1981.
5. Nihat Ozkaya, Margareta Nordin, Fundamentals of Biomechanics: Equilibrium, Motion, and Deformation, Springer- Verlag; 2nd edition, 1999.

6. Margareta Nordin, et al, Basic Biomechanics of the Musculoskeletal System, Lippincott Williams & Wilkins; 3rd edition, 2001.

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 707(P): Medical Embedded Computing and Virtual Bio-Instrumentation Lab

Teaching scheme **Credits 2**
3 hours practical per week

(Any twelve experiments, at least five sections should be covered)

Distributed Computing

- An extensive tutorial on Linux, Linux clustering, steps for building a cluster and brief description of MPI and parallel processing/Setting up and configuring a system to setup an OSCAR cluster
- Introduction to python/PERL programming for bioinformatics and computational biology, applications/TCP/IP, Simbiology and Bioinformatics toolbox based applications
- Lab on a chip experiment: micro fluidics study on glucose detection from Human Physiological fluids (detection of proteins, serum albumin, immunoglobulin, antibody ,antigens) / Bioassay method for detection of proteins, serum albumin, immunoglobulin, antibody, antigens)

Network applications in biomedical engg

- Network/remote control of microscopy equipment and imaging:
- Cell imaging and detection of various organelles (cell counting)
- Web based movement of CCD camera with feedback
- web based motion control of robot assisted surgery

Virtual biomedical applications

- 3D image reconstruction algorithms/OpenGL based image reconstruction(3D rendering)
- VRML and VR Blockset for biomedical 3D imaging application for VR world construction and use of haptic sensors /Force feedback for environment interaction
- Familiarization of(ARM 9/TI MSP 430)architecture and programming and use in one biomedical application
- Network controlled biomedical applications

Biometric computing-facial recognition and fingerprint recognition algorithms

- Machine learning and data mining algorithms for medical applications / Java for biomedical applications-Introduction to java programming: J2ME with CDLC and MIDP programming environment for mobile applications

VHDL for biomedical engineers

Code tools (Altera Quartus and ISE Xilinx).

- Introduction to basic digital circuits with timing constraints
- Simulation of counter/timer states
- Simulation of multiplier, adder
- Simulation of state machine model
- Simulation of Binary to Excess three converter
- Design of a 4 bit ALU with timing constraint
- Design and simulation of GPU unit for Laser speckle imaging

Telemetry applications

- An embedded all-weather precision AC motor drive control system hosting a wireless modem connecting to a host via the Internet
- Sophisticated firmware for drive train control, error alerts, scheduling, maintenance, and wireless network interface for biomedical application in traction control
- High voltage (HVAC) billboard lighting control and power consumption monitoring electronics for maintenance alerts and power conservation in a hospital/primary health care
- A .NET and SQL based web manager for billboard monitoring, control, scheduling, and uptime reporting with maintenance email alerts

Bio-Virtual instrumentation

- Virtual Instrumentation: Introduction to virtual instrumentation programming – simple virtual instruments (Vl)-examples.
- VI for data acquisition of analog/digital inputs.
- VI for processing, analysis, and display of biomedical signals- with visual and sound alarms
- VI that generates a signal and displays it on the front panel.
- Convert C to F subVI - to read a temperature from the DAQ Signal Accessory in Celsius or Fahrenheit.
- VI to read a temperature once every second for one minute.
- Use of array, loops in VI
- To build a VI to display the plot of an equation

References

Computers as Components: Principles of Embedded Computer Systems Design (With CD-ROM) (The Morgan Kaufmann Series in Computer Architecture and Design) by Wayne Wolf
Bioinformatics for Dummies Jean-Michel Claverie & Cedric Notredame
Wiley Publishing, 2003
Introduction to Bioinformatics Arthur Lesk Wiley Publishing
Building Linux Clusters by David HM Spector
Building Clustered Linux Systems (HP Professional Series) by Robert W. Lucke

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Laboratory practical and record
30% - Test/s
10% - Regularity in the class

Semester-End Examination *(Maximum Marks-50)*

70% - Procedure and tabulation form, Conducting experiment, results and inference
20% - Viva voce
10% - Fair record

BM09 708(P): Biomedical Signal Processing Lab

Teaching scheme **Credits 2**
3 hours practical per week

Objective
To acquaint the students with the processing of biomedical signals using suitable software tools. (like Turbo C/MATLAB/Mathematica/Octave/Scilab)

(Any twelve experiments)

1. (i) addition (ii) multiplication (iii) convolution (iv) shitting on simulated discrete-time signals
2. Obtaining DTFT and FFT on simulated discrete-time signals
3. ECG data acquisition.
4. QRS detection and heart rate measurements
5. Correlations and template matching
6. Frequency analysis of ECG/EMG signal
7. FIR Filter Design (LP/HP/BP/Notch)
8. IIR Filter Design -Butterworth (LP/HP/BP/Notch)
9. IIR Filter Design – Chebyshev (LP/HP/BP/Notch)
10. ECG Data compression
11. Adaptive filters
12. Display of an image, negative of the image, histogram and contrast stretching, binary image.
13. Low-pass, High pass and median filtering of images, edge detection by gradient filters.
14. Histogram equalization and specification of images.
15. Image compression techniques – variable length & fixed length code.
16. Familiarization of DSP hardware kit
17. Programming on DSP hardware kit
18. Interfacing of on chip peripherals with a DSP kit
19. Design of IIR filter using DSP hardware kit

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Laboratory practical and record
30% - Test/s
10% - Regularity in the class

Semester-End Examination *(Maximum Marks-50)*

70% - Procedure and tabulation form, Conducting experiment, results and inference
20% - Viva voce
10% - Fair record

BM09 709(P): Project

Teaching scheme **Credit:** 1

1 hour practical per week

Objectives

- *To judge the capacity of the students in converting the theoretical knowledge into practical systems/investigative analysis.*

Project work is for duration of two semesters and is expected to be completed in the eighth semester. Each student group consisting of not more than five members is expected to design and develop a complete system or make an investigative analysis of a technical problem in the relevant area. The project may be implemented using software, hardware, or a combination of both. The project work may be undertaken in biomedical/electronics//instrumentation engg. or any allied area and must have relevance in biomedical engineering. Project evaluation committee consisting of the guide and three/four faculty members specialised in biomedical/electronics/instrumentation engg. will perform the screening and evaluation of the projects.

Each project group should submit project synopsis within three weeks from start of seventh semester. Project evaluation committee shall study the feasibility of each project work before giving consent. Literature survey is to be completed in the seventh semester.

Students should execute the project work using the facilities of the institute. However, external projects can be taken up in reputed industries, if that work solves a technical problem of the external firm. Prior sanction should be obtained from the head of department before taking up external project work and there must be an internal guide for such projects.

Each student has to submit an interim report of the project at the end of the 7^{th} semester. Members of the group will present the project details and progress of the project before the committee at the end of the 7^{th} semester.

50% of the marks is to be awarded by the guide and 50% by the evaluation committee.

Internal Continuous Assessment

20% - Technical relevance of the project
40% - Literature survey and data collection
20% - Progress of the project and presentation
10% - Report
10% - Regularity in the class

EIGHTH SEMESTER

BM09 801: Communication Systems

Teaching scheme **Credits 5**

4 hours lecture and 1 hour tutorial

Objectives

- *This course introduces the various techniques used for transferring information in communication systems. Basic ideas of microwave communication, spread spectrum communication, telemetry, optical communication etc are also covered.*

Module I (18 hrs)

Electromagnetic spectrum-Elements of a Communication System-Classification of communications-Transmission Lines, (Brief description only)-basic types, characteristic impedance, SWR, Antennas (brief description only) - antennas operation, basic antenna types-RF wave propagation (brief description only)-modulation-AM principle, generation-SSB techniques-principle, generation-angle modulation-theory and generation of PM and FM-Comparison of AM, PM, FM

Module II (18 hrs)

Super heterodyne receivers- Receiver parameters – AM receivers- IF and its selection, automatic gain control, AM demodulator circuits, SSB receivers, demodulation of SSB, receiver types, FM receiver-FM demodulators, FM noise suppression, Pulse modulation, Principle of PAM, PWM & PPM modulation and demodulation

Module III (19 hrs)

Digital communication-baseband transmission and.reception-digital carrier system-PCM, Delta modulation, DPCM, generation and demodulation, Signal to noise ratio, Digital modulation schemes-ASK, FSK, PSK, DPSK, M-ary signaling schemes –multiplexing – TDM, FDM, WDM

Microwave communication –Basic principle.Spread spectrum communication-general concepts. Wireless telemetry-Modulation system ,choice of radio carrier frequency,Transmitter,Receiver.ECG telemetry system.Transmission of analog physiological signals over telephone.Telemedicine-concepts,essential

Module IV (17 hrs)

Fibre optics-General concepts ,Transmission characteristics of fibers-absorption losses ,scattering losses,dispersion. Optic fiber and its properties: Introduction, Basic fiber construction, propagation of light, Propagation of Image, Modes of operation, Refractive Index profile, Types of fibers.

Fiber optics transmission ,Optical sources-principle,modulation characteristics,photodetectors-Principle,circuit & performance,Fibre production method ,Fibre optic connectors,couplers and splices, Optical transmitters and receivers.

Text Books

1. W. Tomasi, Electronic Communication System, Pearson Education, Delhi, 2001
2. D. Roddy and J. Coolen, Electronic Communications, 4th ed., Pearson Education, Delhi, 2000
3. L. Frenzel, Ji., Communication Electronics, 3rd ed., Tata McGraw Hill, New Delhi, 2000
4. John M.Senior,Optical Fiber Communications,Prentice Hall of India,2002
5. R S Khandpur"Handbook of biomedical instrumentation",Tata Mc Graw Hill.
6. C K Sarkar,"Optoelectronics & fiber optic communication",New Age I nternational publishers, 2001

Reference Books

1. D. Patranabis, Telemetry principles, Tata McGraw Hill, New Delhi, 1999
2. T. Viswanathan, Telecommunication Switching System & Networking, Prentice Hall of India, New Delhi, 1997
3. John Gowar,Optical Communication System, Prentice Hall of India,2001

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

PART A: Short answer questions (one/two sentences) *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 802: Biomedical Optics & Microscopy Imaging

Teaching scheme **Credits 3**

2 hours lecture and 1 hour tutorial

Objective:

- *where tissue affects photons used for diagnostic sensing, imaging, and spectroscopy of tissues and biomaterials,*
- *where photons affect tissue, used for surgical and therapeutic cutting, dissecting, machining, processing, coagulating, welding, and oxidizing tissues and biomaterials*
- *Imaging hardware –CCD camera*
- *Types of materials and their optical properties*
- *Basics of microscopy imaging and different techniques involved in microscopic imaging*

MODULE I (9 hours)

Imaging fundamentals, Light matter interaction, reflection, transmission, scattering and absorption .Basics of Optics, Light propagation in tissue, Propagation Modelling, Optical Components, anatomy and Physiology of the eye, properties of vision, Basic Properties of Digital Images: aspect ratio, spatial resolution, image brightness and depth, grayscaling, image histograms and digital image display characteristics, storage formats of images,

Anatomy of a Charge-Coupled Device, Binning , Blooming, Dynamic Range, Quantum efficiency, CCD Noise Sources and Signal-to-Noise Ratio, CCD linearity, Electronic Shutters, Charge Transfer Clocking Schemes: 4 ,3 and two phase clocking schemes, CCd scanning formats, full frame CCD architecture, frame transfer CCD architecture, interline transfer CCD architecture

MODULE II (9 hours)

Types of materials and properties of materials used for Spectroscopy, cuvette and flowcell selection in spectroscopy. Optical properties of typical materials used in optics and spectroscopy and laser endoscopy. Photonic crystals and metamaterials, bioderived materials, bioinspired materials, biotemplates, bacteria as biosynthesizers for photonic polymers, semiconductor quantum dots, optoelectronic sensor material and semiconductor material properties

MODULE III (9 hours)

Timeline of microscopy and evolution of microscopy imaging .Introduction to microscopy, Lenses and Geometrical Optics, Concept of magnification, microscope optical components, illumination. Microscopy techniques: brightfield, darkfield,

phase contrast, DIC, polarization and fluorescence; Advanced techniques:
Confocal microscopy, fluorescence lifetime measurement, FRET, multiphoton microscopy
Light sources, Koheler illumination, Rheinberg Illumination -, illumination with transmitted and reflected light, Image brightness, Microscope objectives:
Eyepiece ,sub stage condensers ,specimen stage microscopy, basic microscope ergonomics, Prisms and beam splitters Introduction to Lasers - Laser Systems for Optical Microscopy
Types of microscopes and microscopy: simple and compound Fluorescence Microscopy, confocal, optical, inverted and phase microscopy, contrast enhancement techniques, Portable laser-induced lifetime fluorescence spectroscopy and imaging instruments Nonparametric numerical methods for fast analysis of time-resolved fluorescence data ,Studies of fiberoptic probe designs for spectroscopic investigation of tissues Fluorescence ,lifetime imaging microscopy (FLIM) techniques ,Optical MEMS for surgical microsystems ,Minimally invasive surgical systems

MODULE IV (9 hours)
Digital Imaging in Optical Microscopy, Electronic Imaging Detectors, fundamentals of video imaging, Introduction into CMOS image sensors, basic concepts in digital image processing, deconvolution in optical microscopy, background subtraction techniques
Optical Microscopy for Biomedical Applications: Fluorescent Protein Fluorophore Maturation Mechanisms , Rat Brain Tissue Sections , Co-Localization of Fluorophores in Confocal Microscopy, Choosing Fluorophore Combinations for Confocal Microscopy , Matching Fluorescence Filter Blocks with Fluorescent Probes, Fluorescence Microscopy of Cells in Culture. Optical Coherence Tomography, Cancer imaging; Other topics: optical chem/bio sensors, optical tweezers, Nano particles in biophotonics (Basics of surface plasmons, radiative decay engineering for modulation of fluorescence and Raman signals, representative results)
Lab on a chip (Basic ideas and implementation).

Text books

1. Bahaa Saleh and Malvin Teich, Fundamentals of Photonics, Wiley & Sons (1991)
2. Paras N. Prasad, Introduction to Biophotonics, Wiley & Sons (2003)
3. John D Joannopoulos et al.,Photonic crystals, molding the flow of light, New Jersey, Princeton,2008
4 James Pawley ,Handbook of Biological Confocal Microscopy (The Language of Science**)**
5.Thomas Szabo , Isaac Bankman , Reinaldo Perez , John Semmlow , Mark E. Brezinski Biomedical Imaging and Signal Processing
6. Lihong v wang ,Hsin-I Wu ,Biomedical Optics, Principles and Imaging , ,John Wiley
7 Website for Olympus Microscopy Resource Center: Digital Imaging in Optical Microscopy - Concepts in Digital Imaging

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 805(P): Seminar

Teaching scheme **Credits:** 2

3 hours per week

Objective

To assess the ability of the student to study and present a seminar on a topic of current relevance in biomedical/electronics/computer science/instrumentation engg. or allied areas.

It enables the students to gain knowledge in any of the technically relevant current topics and acquire the confidence in presenting the topic. The student will undertake a detailed study on the chosen topic under the supervision of a faculty member, by referring papers published in reputed journals and conferences. Each student has to submit a seminar report, based on these papers; the re-

port must not be reproduction of any original paper. A committee consisting of three/four faculty members will evaluate the seminar.

Internal Continuous Assessment
20% - Relevance of the topic and literature survey
50% - Presentation and discussion
20% - Report
10% - Regularity in the class and Participation in the seminar

BM09 806(P): Project

Teaching scheme
11 hours practical per week

Total Credits: 7
Credits for interim evaluation: 2
Credits for final evaluation: 5

This project work is the continuation of the project initiated in seventh semester. The performance of the students in the project work shall be assessed on a continuous basis by the project evaluation committee through progress seminars and demonstrations conducted during the semester. Each project group should maintain a log book of activities of the project. It should have entries related to the work done, problems faced, solution evolved etc.

There shall be at least an Interim Evaluation and a final evaluation of the project in the 8th semester. Each project group has to submit an interim report in the prescribed format for the interim evaluation.

Each project group should complete the project work in the 8th semester. Each student is expected to prepare a report in the prescribed format, based on the project work. Each student is expected to prepare a report and a technical paper in the prescribed format, based on the project work. The paper may be prepared as per IEEE standard and can have a maximum of eight pages. Members of the group will present the relevance, design, implementation, and results of the project before the project evaluation committee comprising of the guide, and three/four faculty members specialised in biomedical/electronics/computer science/instrumentation engg.. .

50% of the marks is to be awarded by the guide and 50% by the evaluation committee.

Internal Continuous Assessment
40% - Design and development/Simulation and analysis
30% - Presentation & demonstration of results
20% - Report
10% - Regularity in the class

BM09 807(P): Viva-Voce

Credits: 3

Objective

- *To examine the knowledge acquired by the student during the B.Tech. course, through an oral examination*

The students shall prepare for the oral examination based on the theory and laboratory subjects studied in the B.Tech. Course, mini project, seminar, and project. There is only university examination for viva-voce. University will appoint two external examiners and an internal examiner for viva-voce. These examiners shall be senior faculty members having minimum five years teaching experience at engineering degree level. For final viva-voce, candidates should produce certified reports of mini project, seminar, and project (two interim reports and main report). If he/she has undergone industrial training/industrial visit/educational tour or presented a paper in any conference, the certified report/technical paper shall also be brought for the viva-voce.

Allotment of marks for viva-voce shall be as given below.

Assessment in Viva-voce
40% - Subjects 30% - Project and Mini Project 20% - Seminar 10%- Industrial training/industrial visit/educational tour or Paper presented at National-level

BM09 L06: Embedded System Design

Teaching scheme **Credits 4**
3 hours lecture and 1 hour tutorial

Objectives

- *To impart knowledge on the concepts of embedded systems.*
- *To provide knowledge on the microcontrollers 8051 and 80196, and a peripheral interface controller and thus enable students to design embedded systems.*

Module I (14 hours)
An Introduction to Embedded Systems: Real-Time Systems. Hard Real-Time. Soft Real-Time. Real-Time Embedded Systems. Embedded Processors. The Advent of PC Embedded Systems. PC Hardware Components. Embedded system Design: Tools and components

Module II (13 hours)
Embedded System Hardware Approach: Overview of 8051 family, ADC /DAC Interface issues, Timer/Counter Programming in the 8051. 8051 Serial Communication. Interrupts Programming. Real World Interfacing: Sensors. Stepper Motor, Keyboard, DAC. 8051/31 Interfacing to External Memory.

Module III (13 hours)
Serial communication using I2C, CAN, USB buses; parallel communication using ISA, PCI, PCI/X buses, arm bus. Peripheral Interface Controller (PIC) - General architecture-PIC16F84-Architecture-Addressing modes-Instructkm set-Simple Programming (Not in detail) .

Module IV (14 hours)
Embedded System Software: Round-Robin with Interrupts. Function-Queue-Scheduling Architecture. Introduction to Real-Time Operating Systems. Real-Time Operating System Architecture. Selecting an Architecture. Tasks and Task States. Tasks and Data. Real Time and Embedded Linux: Features

Text Books

1. M. A. Mazidi and J. G. Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson Education, Delhi, 2004

2. D. E. Simon, An Embedded Software Primer, Pearson Education, Delhi, 2004

Reference Books

1. C. Hollabaugh, Embedded Linux: Hardware, Software, and Interfacing, Pearson Education, Delhi, 2004.
2. R. Grehan, R. Moote, and I. Cyliax, Real- Time Programming: A Guide to 32-bit Embedded Development, Pearson Education, Delhi, 2004.
3. Intel Data Book Vol. I, Embedded Microcontrollers and Processors.
4. Intel Data book, EBK 6496-16 bit embedded controller Hand book
5. Intel Data book, EBK 6485 Embedded Microcontrollers Data book

PIC Data Manual, Microchip, 2002

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 L07: DSP Controllers

Teaching scheme **Credits 4**

3 hours lecture and 1 hour tutorial

Objectives

- *To provide in depth understanding of the architecture of TMS320C6x family of processors.*
- *To train students in writing programming examples using C/assembly language for TM-S320C64x processor.*
- *To give an introduction to DSP development systems*

Module I (14 hours)

Architecture of TMS 320C6x-functional units-fetch and execute-pipelining-registers-addressing modes-instruction sets-timers- interrupts-serial ports-DMA-memory.

Module 11 (14 hours)

Fixed and floating point formats-code improvement-constraints-TMS320C64x CPU-simple programming examples using C/assembly.

Module III (I3 Hours)

Review of FIR, IIR filters-DFT and FFT. Adaptive filters-examples for noise cancellation and system examples-code optimizationion- procedure-software pipelining.

Module IV (13 hours)

Typical DSP development systems-support tools and files-compilers-assemblers-code compressor studio-codecs-DSP application examples in codec, voice scrambling, PLL, AI, image processing, FSK modems, voice detection and reverse playback, multi rate filters, PID controllers.

Text Book

R. Chassaing, DSP applications using C and the IMS 320C6x DSK, Wiley, 2002

Reference Books

1.B. Venkataramani and M. Bhaskar, Digital Signal Processors, Tata McGraw Hill, New Delhi, 2002

2.N. Kehtamavaz, Real-Time Digital Signal Processing: Based on the TMS320C6000, Elsevier, 2004
3.S. A. Tretter, Communication System Design using DSP algorithms: with Laboratory Experiments/or the TMS320C6700, Kluwer Academic Publishers, 2003.
4.N. Kehtamavaz, DSP System Design: Using the TMS320C6000, Prentice-Hall, New Jersey, 2001.

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 L08: Advanced Medical Instrumentation

Teaching scheme **Credits 4**
3 hours lecture and 1 hour tutorial

Objective
This course imparts the information on the principle and working of various advanced medical instruments such as microprocessor based ECG machines, Sund stimulators, Brain mappers, Microprocessor based pulse oxirneters, etc..

Module I (13 hours)
Microprocessor based ECG machines. Holier monitoring. TMT system. Digital central monitoring systems for patient monitoring. Design concepts. Advanced computer based arrhythmia detection system-software design protocols.

Module II (14 hours)
Sound stimulators- Measurement of average auditory evoked potential - application- Photo stimulators-Visually evoked potential measurement and application - Recording- Amplifiers - Analysis and storage - Brain mappers (EEG)- principles and measurements, Computerized tonometer, Keratometers.

Module III (13 hours)
Impedance techniques: Bipolar and retrapolar circuits, detection of physiological activities using impedance techniques - cardiac output, neural activity, respiratory activity, impedance plethysmography- resistance and capacitance type. Spirometer. Microprocessor based pulse oximeters.

Module IV (14 hours)
Advanced analytical aids - Fundamentals of NMR spectroscopy, X-ray spectrometers, mass spectrometers, Raman and Moss Beer spectroscopy. Blood Gas Analyser, Automated Biochemical analysis Systems. Principles of scanning and transmission electror microscopy. Principles of simple, compound and phase contrast microscopes.

Text Books
1. John G. Webster, Medical Instrumentation Application and Design, John Wiley and Sons,

New York
2 Keith H. Chiappa, Evoked potential in clinical testing. Lippincott Williams & Wilkins.
3.J. D. Bronzino, The Biomedical Engineering Handbook- Vol. 1 & 2, Boca Raton, FL: CRC Press
4.R.S. Kandhpur, Analytical Instrumentation, Tata McGraw Hill, New Delhi, 2002

Reference Books

1. JohnG. Webster, The Measurement, Instrumentation & Sensors Handbook, CRC Press, 1998.
2. IEEE Medical Electronics Monograph Vol. 7 to 12.
3. S. E. Sutphin, Advanced Medical Instrumentation and Equipment, Prentice Hall, 1987
4. John D. Enderle, Susan M. Blanchard, Introduction to Biomedical Engineering, Academic Press, 1999.
5. Donna Maseric, Neural networks and Artificial Intelligence for Biomedical engineering, Prentice hall of India.

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 L09: Rehabilitation Engineering

Teaching scheme **Credits 4**
3 hours lecture and 1 hour tutorial

Objective
To enlighten the students with the principles and applications of rehabilitation engineering.

Module I (13 hours)
Information Resources-definitions and terminology, Man-Machine Models, System Perspectives, ADA and Legislation.

Module II (14 hours)
Biomechanics Overview: Lower Limb Prosthetics, Elements of Design in Rehabilitation Engineering, Upper Limb Prosthetics, Orthotics (lower limb, upper limb, spinal), User-Support Interfaces & Materials.

Module III (14 hours)
Universal Design: Home/Worksite//School Accommodations, Wheelchairs (biomechanics and design), Seating, Positioning, Ergonomics, Augmentative and Alternative Communication Computer Access.

Module IV (13 hours)
Introduction to Gait Analysis, Neuromuscular Electrical Stimulation, International Rehabilitation Technology & Service, Current R&D, Challenges of Technology Transfer& Future Directions.

Text Books
1.A.M. Cook and S.M. Hussey, Assistive Technologies: Principles and Practices, Mosby.
2.Rory A. Cooper, Rehabilitation Engineering Applied to Mobility and Manipulation. Institution of Physics Publishing
3. Rehabilitation Engineering. Bditors: Raymond V. Smith ar‹i John H. Leslie. CRC Press.

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 L10: Principles of Radiography & Radiology_

Teaching scheme **Credits 4**

3 hours lecture and 1 hour tutorial

Module I (14 Hours)

Production of X-rays Various components of radiographic systems Electrical circuit for X-ray unit filament circuits and mA control- IITV circuits - KV control exposure switching and control of exposure timers - types of X -ray tubes for various medical applications .. Rating charts of X -ray tubes .

Module II (13 Hours)

Scattered radiation & its control in radiography collimators bucky grids absorbed dose - Basics of tables & arms. Fluoroscopy systems TV chain for fluroscopy Properties of X-ray films &screens- Characteristics of imaging system - modulation transfer function.

Module III (14 Hours)

Automatic exposure controls - Photo timers - types - limitations - performance - serial film chargers types - radiographic considerations - film exposure time - photo timer applications - automatic brightness control system.

Basic of digital angiography - Image processors for digital angiography - processor architecture -Temporal integration techniques for digital angiography- digital subtraction angiography

Module IV (13 Hours)

Physical principles of radio therapy. Dosage data for clinical applications. Measurement of output and use of ISODOSE charts. Collimators and beam direction devices. Telemetry sources and acceptancecalibration. Safety protocols & protection. Principles of linear accelerators for radiation therapy.Radiation therapy planning.

Text Books :

1. Massey & Meredith , "Fundamental Physics of Radiology",
2. John Wright & Sons
3. Webb S, " The Physics of Medical Imaging", Adam Hilger, Bristol
4. Thomas Thompson , "A Practical Approach to Modern Imaging Equipment" ,.Little Brown elo

5. Sybil M Stockley, " A Manual of Radiographic Equipments", Churchill Livingstones
6. Chistrmis, "Physics of Diagnostic Radiology"

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 L11: Soft Computing Techniques

Teaching scheme **Credits 4**

3 hours lecture and 1 hour tutorial

Objectives:

- *To acquaint the students with important soft computing methodologies-neural networks, fuzzy Iogic, genetic algorithms and genetic programming.*

Module I (13 hours)

Artificial intelligence systems- Neural networks, fuzzy logic, genetic algorithms. Artificial neural networks: Biological neural networks, model of an artificial neuron, Activation functions, architectures, characteristics-learning methods, brief history of ANN research-Early ANN architectures (brief study)-McCulloch & Pitts model, Perceptron, ADALINE, MADALINE

Module II (13 hours)

Backpropagation networks: architecture, multilayer perceptron, back propagation learning-input layer, hidden layer, output layer computations, calculation of error, training of ANN, BP algorithm, momentum and learning rate, Selection of various parameters in BP networks.

Variations in standard BP algorithms- Adaptive learning rate BP, resilient BP, Levenberg-Marquardt, and conjugate gradient BP algorithms (basic principle only)-Applications of ANN

Module III (14 hours)

Fuzzy Logic-Crisp & fuzzy sets - fuzzy relations - fuzzy conditional statements - fuzzy rules - fuzzy algorithm. Fuzzy logic controller - fuzzification interface -knowledge base - decision making logic - defuzzification interface - design of fuzzy logic controller - case studies.

Module IV (14 hours)

Genetic algorithms - basic concepts, encoding, fitness function, reproduction-Roulette wheel, Boltzmann, tournament, rank, and steady state selections, Elitism. Inheritance operators, Crossover-different types, Mutation, Bit-wise operators, Generational cycle, Convergence of GA, Applications of GA - case studies. Introduction to genetic programming- basic concepts.

Text Books

1. R. Rajasekaran and G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications, Prentice Hall of India, New Delhi

2. L. Fausett, Fundamentals of Neural Networks, Prentice Hall, Upper Saddle River, N.J

Reference Books

1.D. E. Goldberg, Genetic Algorithms in Search, Optimisation, and Machine Learning, Addison-Wes]ey, Reading, MA, 1989.

2.M. T. Hagan, H. B. Demuth, and M. H. Beale, Neural Network Design, PWS Publishing, Boston, MA, 1996.

3.T. Ross. Fuzzy Logic with Engineering Applications, Tata McGraw Hill, New Delhi, 1995

4.J. R. Koza, Genetic Programming: On the Programming of Computers by Natural Selection, MIT Press, Cambridge, 1992.

5. B. Yegnanarayana. Artificial Neural Networks. Prentice Hall of India, New Delhi, 1999.

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 L12: Data Communication

Teaching scheme **Credits 4**

3 hours lecture and 1 hour tutorial

Objective

This course enriches the students with the knowledge of

- *data communication and networking*
- *digital data communication techniques*
- *computer networks such as LAN, WAN.*

Module I (14 hrs)

Data communication and networking overview- Data communication, data communication networking, - Examples of networks - PSDN & Broadband networks, Multi-service networks, standards, Data transmission, concepts, analog and digital transmission, transmission impairment, channel capacity - Guided and Wireless transmission - Signal encoding Techniques.

Module II (13 hrs)

Digital data communication Techniques - Asynchronous and Synchronous Transmission - Bit / character oriented synchronisation - Errors - Error detection methods - parity, cyclic redundancy - Error correction circuits - common circuits -interfacing - characteristics - communication control devices statistical, time division multiplexing, asymmetric digital subscribers line - XDSL, spread spectrum and code division multiple access (Brief description only) - Protocol basics – Data link control protocol, Flow control, Error control, Link management.

Module III (14hrs)

Computer networks - local area networks, wired LANs - topologies and transmission media - Medium access control methods LAN protocol - Architecture, Bridges, wireless LANs - Technology, high speed LANs - Ethernet switching—FDDI, Bridges wide area networks - Circuit switching and Packet switching, asynchronous transfer mode, routine and congestion control in switched data networks- cellular wireless network -

Module IV (13 hrs)

Communication architecture and protocol — Internet working - architecture, protocol standards, transport protocol - internet work protocol -application support protocols -network security - distributed application.

Text Books

1. W. Stallings, Data and Computer Communications. Pearson Education, Delhi, 2003
2. F. Halsall, Data Communications. Computer Networks and Open Systems,4th ed., Pearson Education, Delhi, 2002.

Reference Book

1. B. A. Forouzan, Data Communications and Networking. 3rd ed., Tata Mc-Graw Hill, New Delhi. 2004

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 L13: Advanced Signal Processing

Teaching scheme **Credits 4**

3 hours lecture and 1 hour tutorial

Objectives

This course aims to introduce the following topics of advanced signal processing

- *Multirate system fundamentals and multirate filter banks*
- *Wavelet transform and its applications*

Module I (1 3 hours)

Multirate system fundamentals-Basic multirate operation - up-sampling and down sampling; Tims domain and frequency domain analysis- Identities of multirate operations- Interpolator and decimator design- Rate conversion- Polyphase representation.

Module II (14 hours)

Multirate Filter banks-Maximally decimated filter banks-Quadrature mirror filter (QMF) banks - Polyphase representation-Errors in the QMF bank. Aliasing and Imaging-Method of cancelling aliasing error. Amplitude and phase distortion. Prefect reconstruction (PR) QMF bank - PR condition. M-channel perfect reconstruction filter banks

Module III (13 hours).

Wavelets-Fundamentals of signal decomposition - brief overview of Fourier transform and short time Fourier transform - time frequency resolution - Continuous wavelet transform - different wavelets- DWT - wavelet decomposition - approximation of vectors in nested linear vector spaces - example of MRA - orthogonal wavelet decomposition based on the Haar wavelet -digital filter implementation of the Haar wavelet decomposition (Mallar's algorithm).

Module IV (14 hours)

Wavelet applications-Image compression - EZW algorithm - Audio compression - signal denoising techniques- different types-edge detection. Lossless compression

Text Books

1.P. P. Vaidyanathan, Multirate Systems and Filter Banks, Pearson Education, Delhi, 2004

2.K. P. Soman and K. I. Ramachandran, Insight into Wavelets, Prentice Hall of India, New Delhi, 2004

3.G.Strang and T.Nguyen, Wavelets and Filter Banks, Wellesley-Cambridge Press, MA,1996.

Reference Books

1. M. Vetterli and J. Kovacevic, Wavelets and Subband Coding, Prentice-Hall, Englewood Cliffs- I. J., 1995
2 S. K. Mitra, Digital Signal Processing: A Computer Based Approach, 2nd ed., Tata Mc-Graw Hill, New Delhi, 2001
3. C. S. Burrus, R. A. Gopinath, and H. Guo, Introduction to Wavelets and Wavelet Transform A Primer, Prentice Hall, Englewood Cliffs, N.J., 1997

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 L14: Fundamentals of BIOMEMS and Medical Microdevices

Objectives

To make the students familiarized with

- *Microfabrication of silicon,glass and polymer devices*
- *Principles of microfluidic and electrokinetic devices*
- *Sensors ,actuators and delivery systems*
- *Micro total analysis systems (μTAS) and Lab-on-a-chip(LOC)*
- *Introduction to clinical lab medicine*
- *Detection and measurement devices*
- *Genomics and Proteomics,DNA and protein micrarrays*
- *Emerging MEMS technologies in medicine ,research and homeland security*
- *Packaging, power and RF safety in MEMS*

Module I (14 hours)

An Introduction to electromechanical devices,BioMEMS-introduction to medical microdevices, biomaterials and polymer for MEMS devices, silicon manufacturing process. Power, packaging data transmission and RF safety for MEMS. Emerging MEMS technology for medicine, research and homeland security .Biocompatibility, FDA and ISO biological evaluations

Module II (13hours)

Introduction to micro fabrication-hard and soft techniques .Hard fabrication- Lithography, Etching, ion implantation, thin film technique, surface micromachining, electroplating, substrate binding.
Soft fabrication techniques- soft lithography, micromolding, photopolmerization, nanomedicne and thick film techniques

Module III (13 hours)

Microfluidics-principles, sensors-optical, piezoelectric, SAW ,basic and electrochemical detection, microsensors, microfluidic devices, transport phenomena and electrokinetic behaviour, micromixers, valves and pumps. Microactuators and drug delivery-activation methods and equivalent circuits, applications in medicine.

Module IV (14 hours)

Introduction to clinical laboratory medicine-chemistry,hematology, immunology, microbiology, coagulation assays,Lab-on-a-chip, μTAS, capillary electrophoresis and cell based bioassays.Introduction to bioinformatics –Genomics and DNA microarray.Proteomics and Protein

microarrays. Drug discovery-pharmacogenomics and pharmacoproteomics and drug discovery and development.

Text Books

Fundamentals of BioMEMS and Medical Microdevices, Steven S Saliterman ,USA, 2006.

Reference Books

1. Wang, Wangjun and Soper,Steven A. (2007). Bio-MEMS: Technologies and Applications. United States of America: CRC Press.
2. Lee, Abraham P. and Lee, L. James (2006). BioMEMS and Biomedical Nanotechnology Vol. 1 Biological and Biomedical Nanotechnology. United States of America: Springer
3. Ozkan, Mihrimah and Heller, Michael J. (2006). BioMEMS and Biomedical Nanotechnology Vol. 2 Micro Nano Technology for Genomics and Proteomics. United States of America: Springer.
4. Desai, Tejal and Bhatia, Sangeeta (2006). BioMEMS and Biomedical Nanotechnology Vol. 3 Therapautic Micro Nano Technology. United States of America: Springer.
5. Bashir, Rashid and Wereley, Steve (2006). BioMEMS and Biomedical Nanotechnology Vol. 4 Biomolecular Senging, Processing and Analysis. Springer
6. Fundamentals And Applications of Microfluidics, Second Edition (Integrated Microsystems) by Nam-Trung Nguyen (Author), Steven T. Wereley

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 L15: Artificial Organs and Implants

Teaching scheme **Credits 4**

3 hours lecture and 1 hour tutorial

Objective

- *To introduce various artificial organs such as artificial skin, artificial heart, artificial liver, etc. and their design concepts.*

Module 1 (13 hours)

Introduction to artificial organs. Biomaterials outlook for organ transplant Design considerations, evaluation process. Permanent artificial skin replacement. Ocular and Cosmetic Implants. Neural prostheses - bladder stimulators, cochlear implants.

Module II (14 hours)

Artificial heart and circulatory assist devices: Heart valves - Animal tissue valves: porcine, Mechanical valves: ball valve; disc valve; vascular grafts. Oxygenators -types, Intravenous membrane oxygenerator Ventricular assist devices-Types and functions, Ardficial Heart, artificial blood.

Module III (13 hours)

Concepts of artificial liver, Urological Prosthetic Devices-Flow and mass transport across membranes, Artificial kidneys: Peritoneal dialysis, Hemo-dialysis. Artificial sphincter, Catheters.

Module IV (14 hours)

Prosthetic and Orthopedic devices. The Human Joints - Concept of Total Joint Replacement (arthroplasty), Total Knee Replacement Surgery, knee, prosthesis.

Total hip prosthesis- requirements- different types of components leg replacement. Different types of models, externally powered prosthesis feedback in orthopedic system

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Text Books

1.Albert N Cook and Webster J.G, Therapeutic medical devices, Prentice Hall Inc., New Jercy

2.Kolff W J, Artificial Organs, John Wiley & sons, New York, 1979.

3.J. D. Bronzino, Handbook of Biomedical Engineering Vol I & II, CRC Press, 2000
4.Nigg and Herzog, Biomechanics of the Musculoskeletal System, Wiley Publishers
5.Jan Eirik Ellingsen, S. Petter Lyngstadaas, Bio-Implant Interface: Improving tiiomateriais and Tissue Reactions, CRC Press, 2003

Reference Books

1. Maxine Rosaler, Bionics, Blackbirch Press, 2003.
2. Judith Janda Presnali, Artificial Organs, Lucent Books, 1995
3. Donald L. Wise, Encyclopedic handbook of biomaterials and bioengineering (4 Vols.), .Marcel Dekker, New York, 1995
4. David Williams, Biocompatibility of Orthopedic Implants, (two volumes), CRC Press,

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Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 L16: Bioinformatics

Teaching scheme **Credits 4**
3 hours lecture and 1 hour tutorial

Objective
To impart the following 'concepts regarding bioinformatics
- *Scope of bio informatics*
- *Evolutionary trees and phylogeny*
- *DNA mapping and DNA sequencing.*

Module I (14 hours)
What is bioinformatics - Scope of bioinformatics - Elementary commands and Protocols - FTP - Telnet - HTTP – Primer on life science and genetics,Primer on information theory. Sequencing alignment and dynamic programming – Introduction to Graph theory - Strings –LCS, Edit distance between two strings - string similarity - local alignment - gaps - parametric sequence alignments - -subtropical alignments – multiple alignment - common multiple alignment methods. Needlman Wunsch and Smith Waterman algorithms, -.

Module II (13 hours)
Sequence databases and their use - Introduction to databases :NCBI, EBI,EMBL, DDBJ, PDB, GenBank, Entrez, OMIM, Locus Link database search – Information retrival from databases Algorithms issues in databases – Amino acid substitution matrices PAM and BLOSSUM, search sequence, database search - FASTA - BLAST tools,Clustal , T Coffee, Genomic mapping and mapping Databases, type of maps, Comparative Genomic analysis-Reconstruction of Metabolic Pathways

Module III (13 hours)
Evolutionary basis of sequence alignment ,Evolutionary trees and phylogeny, DNA molecular clock, homology in genes Phylogenetic trees- Tree building methods - parsimony -Ultra metric problem perfect phylogeny – Phylogenetic alignment - connection between multiple alignment and tree construction, Phylogenetic tree data analysis – 4 steps

Module IV (14 hours)
Special topics in bioinformatics, DNA Mapping -and sequencing - Map alignment - Large scale sequencing and alignment - Shotgun - DNA sequencing - Sequence assembly - Gene predictions - Molecular predictions with DNA strings - Neural network and cybernetics - genetic algorithms.

Predictive methods using DNA and protein sequences-motifs and patterns tertiary structures, Protein folding problem. RasMol ,Introduction to Drug Discovery, DNA sequencer

Text Book

1.P. Baldi, S. Brunk, Bioinformatics, A Machine Learning Approach. MIT Press

2.Dan Gusfield, Algorithms on Strings Trees and Sequences, Cambridge University Press

3.Richard Durbin et al, Biological Sequence Analysis : Probabilistic Models of Proteins and Nucleic Acids

4.Baxevanis, Ouellette: Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins,

Reference Books

1.Des Hiigins, Willie Taylor, Bioinformatics: Sequence, Structure and Databanks: A Practical Approach, Oxford University Press; 1st ed.,2000

2.Cynthia Gibas, Developing Bioinformatics Computer Skills, O'Reilly; 1 edition, 2001.

3. Bergeron, Bioinformatics Computing, Prentice Hall of India, New Delhi

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 L17: Human Factors in Engineering and Design

Teaching scheme **Credits 4**

3 hours lecture and 1 hour tutorial

Objective

This course discusses the following topics of human factors in engineering

- *Ergonomics*
- *Muscle physiology*
- *Concepts of manual material handling*
- *Anthropometry.*

Module I (14 hours)

Introduction to human factors engineering - relevance of ergonomics. Process of seeing-visual cap abilities-factors affecting visual acuity and contrast sensitivity -human factor aspects of hard copy text and computer screen text, factors in selecting graphic representations symbols, qualitative visual displays and representational displays-process of hearing- principles of auditory displays.

Module II (13 hours)

Muscle physiology-muscle metabolism-respiratory response joint motion study-measure of physiological in-efficiency and energy consumption-work rest cycles-aspects of manual material handling (MMH). Bio-mechanical recommended limits of MMH.

Module III (13hours)

Spatial compatibility -physical arrangement of displays and controls- movement capability - rotary controls and rotor displays movement of displays-orientation of the operator and movement relationships-control orders and control responses human limitations in tracking task.

Module IV (14 hours)

Anthropometry- anthropometric design principles-work space envelope-factors in design of workspace surfaces-principies of seat design-principles of control panel organization. Classification of human errors-dealing with human errors -theories of accident causuation - reducing accidents by altering behaviour.

Text Books

1.Mark S. Sanders & Ernest J. McCormic, Human Factors in Engineering and Design, Mc-GrawHill international Edition, 1993.

2.Terence S. Andre, Aaron W. Schopper, Human Factors Engineering in System Design, British Columbia Teacher, 1997.
3. Wesley E. Woodson, Human Factors Design Handbook, McGraw-Hill Professional; 2nd edition, 1992.

Reference Books

1. Christopher D. Wickens, Introduction to Human Factors Engineering, Prentice Hall; 2nd edition, 2003
2. Peggy Tillman, Human Factors Essentials: An Ergonomics Guide for Designers. Engineers, Scientists, and Managers, Mc Graw-Hill, 1991.

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A:	*Short answer questions (one/two sentences)* All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.	*5 x 2 marks=10 marks*
PART B:	*Analytical/Problem solving questions* Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.	*4 x 5 marks=20 marks*
PART C:	*Descriptive/Analytical/Problem solving questions* Two questions from each module with choice to answer one question.	*4 x 10 marks=40 marks*

Maximum Total Marks: 70

BM09 L18: Robotics and Automation

Teaching scheme **Credits 4**
3 hours lecture and 1 hour tutorial

Module I (13 hours)
Basic Concepts: Definition and origin of robotics – different types of robotics – various generations of robots –degrees of freedom – Asimov's law s of robotics – dynamic stabilization of robots.

Module II (14 hours)
Power Sources and Sensors: Hydraulic, pneumatic and electric drives – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging-laser – acoustic – magnetic, fiber optic and tactile sensors.

Module III (13 hours)
Manipulators, actuators and grippers: Construction of manipulators – manipulator dynamics and force control –electronic and pneumatic manipulator control circuits – end effectors – U various types of grippers – design considerations.

Module IV (14 hours)
Kinematics and Path Planning: Solution of inverse kinematics problem – multiple solution jacobian workenvelope – hill climbing techniques – robot programming languages. Case Studies: Multiple robots – machineinterface – robots in manufacturing and non-manufacturing applications – robot cell design – selection of robot.

Text Books
1. P. Mikell, G. M. Weiss, R. N. Nagel, and N. G. Odraj, *Industrial Robotics*, McGraw-Hill
2. B. K. Ghosh, *Control in Robotics and Automation: Sensor Based Integration*, Allied Publishers, Chennai

Reference Books
1. S. R. Deb, *Robotics Technology and Flexible Automation*, Tata McGraw Hill, New Delhi, 1994.
2. R. P. Klafter, T. A. Chmiclewski, and M. Negin, *Robotics Engineering: Integrated Approach*, Prentice Hall of India, New Delhi, 1994.
3. C. R. Asfahl, *Robots and Manufacturing Automation*, John Wiley & Sons, New York

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 L19: Regulation and Control of Physiological Systems

Teaching scheme **Credits 4**
3 hours lecture and 1 hour tutorial

Objective

- *To introduce an analytical and quantitative approach in describing the basic "components" of physiological regulators and control system. (Glucose regulation, mean arterial pressure regulation etc…)*

Module 1 (13Hours)
Introduction to physiological regulators and control systems- purpose of modeling, general properties of PRCs, properties of linear time varying and non-linear systems, parametric control.
Physical and chemical factors governing the behavior of physiological regulators and control systems- behavior of fluid systems under laminar flow conditions, diffusion dynamics and ficks first law, mass action kinetics in chemical systems.

Module 2 (13Hours)
Introduction to SISO control systems and system with delays- Conventional controllers for linear plants with real poles, the use of root locus in linear control system design, some tests for stability in linear and certain classes of nonlinear control systems, linear closed loop systems with delay: stability problems.
Introduction to compartmental modeling and pharmacokinetic systems- basic compartmental analysis, the use of washout curves and bolus inputs to identify the parameters of simple CPK systems, overview of drug input controllers.

Module 3 (14Hours)
Special types of closed loop drug input controllers- design of On/Off limit-cycling controllers for CPK/P systems, nonlinear decoupling controllers for two input/two output CPK systems, integral pulse frequency modulation controllers, introduction to nonlinear parameter- switching controllers: analysis in phase plane
Hormonal regulation of sodium, potassium, calcium and magnesium ions- implicit summing point in hormonal regulation, introduction to physiology of kidneys, regulation of plasma sodium ion and osmolarity, regulation of plasma potassium ions by the aldosterone system, calcium and magnesium ion regulation.

Module 4 (14Hours)

Regulation of blood glucose- molecules important in normoglycemic regulation, normal blood glucose regulation system, a model for blood glucose regulation, the Cobelli and Mari model for glucoregulation, diabetes mellitus, exogenous glucoregulation: the artificial beta cell
Control of postoperative pain by self administered opioids- the neurophysiological and pharmacological basis for pain, the PCA system of Reasbeck and Jacobs, the PCA model of Liu and Northrop

Text Books

1. Robert B. Northrop, Endogenous and Exogenous Regulation and Control of Physiological Systems, Chapman & Hall/CRC
2. K. Ogata, Modern Control Engineering, 4lh ed., Pearson Education, Delhi, 2002.

Reference Books

1. Michel C Khoo, Physiological Control Systems -Analysis, simulation and estimation, Prentice Hall of India, 2001.
2. K. Ogata, Designing Linear Control Systems with MATLAB, Prentice Hall, Englewood Cliffs, 1994
3. Milsum John H. , Biological Control Systems Analysis, McGraw-Hill, 1996
4. D.A. Linkens E. Carson, Modeling and Control in Biomedical Systems 1997 (including Biological Systems) (IFAC Proceedings Volumes) (Paperback)

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 L20: Biostatistics

Teaching scheme **Credits 4**

3 hours lecture and 1 hour tutorial

Objectives:

- *Calculate common probability distributions and apply those calculations to solve problems based on biological studies*
- *randomly allocate experimental units to treatments and apply this technique to solve problems based on biological studies*
- *calculate the distribution of observations about the mean based on the assumption of normality and apply those calculations to solve problems based on biological data*
- *calculate the distribution of sample means about the mean and apply those calculations to solve problems based on biological data design simple biological experiments*
- *compare two means (from paired and unpaired data) using both parametric and non-parametric methods and use those methods to test hypotheses analyze categorical data to test both goodness-of-fit and contingency hypotheses*
- *compare more than two means using analysis of variance methods and use those methods to test hypotheses derived from both single-factor and two-factor experimental designs*
- *calculate least-squares regression lines and apply those calculations to solve problems based on biological studies*

Module I (14 Hours)

Introduction; the nature & history of statistics. Types of data and data coding. Sampling :Random sampling, sampling and frequency distributions. Population, Sample, variable, parameter, primary and secondary data, screening and representation of data.

Normal distribution: parameters, tables for SND, tables for any normal distribution; sampling statistics, standard error.Statistical inference, Student's tOne-sample & two-sample t-tests Goodness of fit, chi-square, comparison to a theoretical distribution, contingency tables.

Module II (14 Hours)

Sample space, events, equally likely events. Definition of probability (frequency approach), independent events. Addition and multiplication rules, conditional probability, Examples Bernoulli, Binomial, Poisson and Normal distributions. Frequency distribution, tabulation, bar diagram, histograms, pie diagram, cumulative frequency curves. Discrete data; frequency distributions. Continuous variation: accuracy, precision, significant figures, frequency distributions. Populations & samples. Introduction to central tendency. Descriptive statistics: central tendency, dispersion, variability Probability. Binomial distrib.; limiting distributions: Poisson, normal Mean median, mode, quartiles and percentiles, measures of dispersion: range, variance, standard deviation, coefficient of variation, symmetry: measures of skewness and kurtosis.
Mean and variance of these distributions (without proof). Sketching of p.m.f. and p.d.f, Use of these distributions to describe in biological models. Model sampling and Simulation study.

Module III(13 Hours)

Hypothesis, critical region, and error probabilities. Tests for proportion, equality of proportions, equality of means of normal populations when variance known and when variances are unknown. Chi-square test for independence. P-value of the statistic. Confidence limits, Introduction to one way and two-way analysis of variance. Introduction to ANOVA; one-way ANOVA., Data transformation; ANOVA assumptions; nonparametric alternatives, Two-way and multiway ,ANOVA, Circular distributions: descriptive, inferential.
Scatter plot, correlation coefficient (r), properties (without proof), Interpretation of r, linear regression. Fitting of lines of regression, regression coefficient, coefficient of determination. Linear regression; comparisons of regressions, Correlation., Multiple regression
Multiple regression . Curvilinear regression, Transformation and curve fitting
Path coefficients and path analysis, Discriminant functions; Mahalanobis' distance

Module IV (13 Hours)

Introduction to Internet and use of the same for communication, searching of database, literature, references etc. Introduction to Bioinformatics, Databank search- Data mining, Data management and interpretation, BLAST, Multiple sequence alignment, Protein Modeling, Protein structure Analysis, Docking, Ligplot interactions, Genes, Primer designing, Phylogenetic Analysis, Genomics and Proteomics.

Reference Books

1. Biostatistics : A foundation for Analysis in the Health Sciences 7/E Wayne W. Daniel, Wiley Series in Probability and Statistics.
2. Introductory Statistics. Fifth Edition. (2004) Prem S. Mann. John Wiley and Sons (ASIA) Pte Ltd.
3. Basic Statistics-Aprimer for Biomedical Sciences-(Olive Jean Dunn).
4. Biostatistics-An introductory text - (Auram Gold Stein).
5. Statistics : An Introductory Analysis (Taro Yamane) Harper and Row Publisher
6. Computational Biochemistry, By: C. Stan Tsai, A John Wiley & Sons, Inc., publication.
7. J.H. Zar. BIOSTATISTICAL ANALYSIS, 4th ed. Englewood Cliffs, N.J.: Prentice-Hall.
8. Moore, The Basic Practice of Statistics
9. Rice, Mathematical Statistics and Data Analysis

10. Daniels, Biostatistics: A Foundation for Analysis In the Health Sciences
11. A Course in Mathematical Biology, Gerda de Vries, Thomas Hillen, Mark Lewis, Birgitt SchÃµnfisch, Johannes Muller
12. Mathematical Models in BiologyElizabeth S. Allman, John A. Rhodes
13. Introductory Biostatistics for the Health Sciences: Modern Applications Including Bootstrap (Wiley Series in Probability and Statistics) by Michael R. Chernick (Author), Robert H. Friis
14. Regression Methods in Biostatistics: Linear, Logistic, Survival, and Repeated Measures Models (Statistics for Biology and Health) by Eric Vittinghoff (Author), David V. Glidden (Author), Stephen C. Shiboski (Author), Charles E. McCulloch
15. Biostatistics: A Methodology For the Health Sciences (Wiley Series in Probability and Statistics) by Gerald van Belle (Author), Patrick J. Heagerty (Author), Lloyd D. Fisher (Author), Thomas S. Lumley

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 L21: Signal Compression

Teaching scheme **Credits 4**

3 hours lecture and 1 hour tutorial

Objective

- To impart thorough knowledge on the various algorithms for signal compression.

Module 1 (14 hours)

Compression Techniques - Lossless and Lossy compression. Measures of Performance. Modeling and Coding Uniquely Decodable Codes. Prefix Codes Huffman Coding-Minimum Variance Huffman Codes. Application of Huffman Coding. Lossless Image Compression. Text compression. Arithmetic Coding. Generating a Tag. Deciphering a Tag. Uniqueness and Efficiency of the Arithmetic Code. Comparison of Huffman and Arithmetic coding. Applications. Bi-level Image Compression

Module II (14 hours)

Dictionary Techniques - Introduction- Static Dictionary. The LZ77 Approach. The LZ78 Approach. File Compressio The Graphics Interchange Format-Predictive Coding. The Burrows-Wheeler Transform. CALIC. Run-Length Coding. Differential Encoding. The Basic Algorithm. Prediction in DPCM. Adaptive DPCM. Delta modulation.

Module III (13 hours)

Quantization - Introduction-Scalar quantization-Uniform Quantizer-Adaptive Quantization- Forward Adaptive Quantization-Backward Adaptive Quantization-Nonuniform Quantization-Vector Quantization. Advantages of Vector Quantization over Scalar Quantization. The Linde-Buzo-Gray Algorithm. Lattice Vector Quantizers

Module IV (13 hours)

Transform Coding - Introduction Karhunen - Loeve Transform. Discrete Cosine Transform. Discrete Walsh-Hadamard Transform. Quantization and Coding of Transform Coefficients. Application to Image Compression-JPEG. Subband Coding. Application to Audio-Mpeg

Text Book

1. K. Sayood, Introduction to Data Compression, 2nd ed., Morgan-Kaufmann Publishers, San Fransisco, CA

Reference Books

1.T. M. Cover, J. A.Thomas, Elements ofInformation Theory, John Wiley & Sons, New York, 1991

2.D.,Salomon, Data Compression: The Complete Reference, 2nd ed., Springer-Verlag, K. M. Nelson, Data Compression Book, BPB Publishers, New Delhi, 1998

.

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 L22: Reliability and Quality Control

Teaching scheme **Credits 4**

3 hours lecture and 1 hour tutorial

Objective

- The objective of this course is to provide students with a basic understanding of the approaches and techniques to assess and improve quality and reliability of process and product.

Module I (12 hours)

Definition of reliability - Failure data analysis - mean failure rate - MTTF - MTVF - Bath tub curve - Hazard models - Constant, linearly increasing and weivull- system reliability - series, parallel, mixed, and ' rr ' out of V configuration.

Module II (12 hours)

Reliability improvement - redundancy element, unit, and stand by - optimisation - cost trade off- Faulttree analysis - Constructions of fault-tree - calculations of reliability from fault-tree - reliability allocation - evaluation of reliability - test - O.C.curve specifying reliability acceptance test.

Module III (14 hours)

Definition of Quality - Quality control design - Product development cycle - Quality planning of manufacturing process - process selection and control -inspection and testing -quality audit - organising for quality - quality function – Quality engineering and quality control - Typical organisation for quality : small scale , medium scale and Large scale organisation.

Module IV (14 hours)

Control charts - X and R charts - Construction and analysis - control charts of attributes - P and C charts - Construction and analysis - Sampling inspection - 100% inspection - O.C curves and simple and double sampling plans - introduction to use of sampling tables Economics of Quality - Quality coats - Failure and prevention - Quality manual - Quality motivation - Zero defects program - Quality circles - Concepts of total quality management.

Text Books

1. J M Jurian et al, Quality V Control Handbook, McGraw Hill. New York

2. E L Grant & Levenworth, Statistical Quality Control, MC Graw. Hill
3.B V Geedenko et al, Mathematical Methods of Reliability Theory. Academic Press
4.Mann, R.E Schafer, N.D.Singapurvala, Methods for Statistical Analysis of Reliability and Life Date, John Wiley & Sons.
5. Douglas C. Montgomery, Introduction to statistical quality control. 3rd ed., Wiley, 1996.

Reference Books

1. Dale H. Besterfield, Quality Control, 6Ih ed., Prentice Hall, 2001
2 V Reigenbaum, Total Quality Control, Mc Graw Hill
3. J R Trylol, Quality Control Systems - Procedures for Planning Quality Programs, Mc Graw Hill

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 L23: Operations Research

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

Objective of this introductory course on operations research is to give the students the essential tools of operations research. This will enable them to model and make scientifically based decisions in economic and production environments

Module 1 (13 hours)

Introduction to operation research: OR model, solving the OR model, simulation models, art of modeling, phases of OR study.

Linear programming: Formulation (Identification of decision variables, constructing objective functions and constraints, assumption), Graphical LP solution,

Module II (14 hours)

Simplex Method: Standard LP form, basic solution,, the M-method, the two-phase method, degeneracy, alternative optimal solution, unbounded solution, infeasible solution.

Sensitivity analysis and dual problem : Definition of the dual problem, the relationship between the optimal primal and dual solution, economic interpretation of duality, the dual Simplex method, primal-dual computations, sensitivity analysis

Module III (13 hours)

Transportation Model: Definition of the transportation model, determination of a starting solution, the transportation algorithm, definition of the assignment problem, the Hungarian method.

Network models : Network definition, minimal spanning tree algorithm, shortest route problem, shortest route algorithm, maximal flow model, enumeration of cuts, maximal flow algorithm, CPM, PERT

Module IV (14 hours)

Queuing systems: Elements of a queuing model, role of exponential distribution, birth and death models, steady state measures of performance, single server models
Game theory: Formulation of two person zero sum games, solution of simple games, mixed strategy games(using graphical method and Lp), saddle point condition.

Text Books

1. H. Taha, *Operations Research: an introduction*, 8th Edition, 2007.
2. F. Hillier, *Introduction to Operations Research*, 7th. Ed. December, 2000. McGraw-Hill.
3. W. Winston, *Operations Research: Applications and Algorithms*, Duxbury Press, 2003.

Reference Book

Hilier and Liebermann, *Introduction to Operations Research*, McGraw-Hill, 2001

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 L24: Virtual Instrumentation

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To impart knowledge on the concepts of virtual instrumentation.*
- *To provide knowledge on the data acquisition*

Module 1 (13 hours)
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.

Module II (14 hours)
Programming Techniques, VIS & Sub VIS, loops & charts, arrays, clusters, graphs, case & sequence structures, formula modes, local and global variable, string & file input. Data Acquisition basics, ADC, DAC, DIO, Counters & timers, PC Hardware structure, timing, interrupts, DMA, Software and Hardware Installation

Module III (13 hours)
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.

Module IV (14 hours)
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 Millimeter using Lab view Software, Study of Data Acquisition & control using

Text Books

G. Johnson, *LabVIEW Graphical Programming*, McGraw Hill, New York
L. K. Wells and J. Travis, *LabVIEW for Everyone*, Prentice Hall, New Jersey.
K. James, *PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control*, Newnes, 2000.

Reference Book

Sokoloff , *Basic Concepts of Labview*, Prentice Hall, New Jercy

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

Note: One of the assignments shall be a term-project. The term project shall consist of Design of following Virtual Instruments (any two) using a graphical Programming software.

1. Data Acquisition using Virtual Instrumentation from Temperature transducer.
2. Data Acquisition using Virtual Instrumentation from a Pressure Transducer
3. Creation of a CRO using Virtual Instrumentation.
4. Creation of a Digital Multi-meter using Virtual Instrumentation.
5. Design Variable Function Generator Using Virtual Instrumentation.
6. Creation of Digital Temperature Controller using Virtual Instrumentation.
7. Machine Vision concepts using Virtual Instrumentation

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BM09 L25: System Modeling and Parameter Estimation

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objective

- *Objective of this course is to give basic concepts about modeling of systems and estimation of various parameters of the model. Model of a system helps in forecasting and prediction. These methods can be applied in time series modeling of system.*

Module 1 (13 hours)

Models for dynamic systems - Continuous differential equation models for electrical, mechanical, electromechanical, hydraulic and pneumatic systems. Linearization, Lumped and distributed parameter systems. Transfer function and state space models. Difference equation models for discrete time systems.

Module II (14 hours)

Statistical simulation - Introduction to probability distribution and stochastic processes. Statistical models- AR, MA, ARMA, ARMAX processes. Input - output models. Equation error models. Binomial, Poisson and Markov processes. Generation of uniform and normal random numbers. Testing data for normality.

Module III (13 hours)

Ordinary least square estimation. Development of estimator - examples. Consistency, efficiency, Cramer Rao bound, Maximum likelihood estimation.

Module IV (14 hours)

Generalized least square estimator, Recursive least square estimator. Use of instrumental variables in estimation. Introduction to closed loop identification of linear systems.

Text Books

1. A. Papoulis, S. U. Pillai, *Probability, Random Variables and Stochastic Process*, 4th ed., Tata Mc-Graw Hill, New Delhi, 2002
2. George E. P. Box, Gwilym M. Jenkins and Gregory C. Reinsel, *Time Series Analysis*, Pearson Education, Delhi, 1994.
3. William W. S. Wei, *Time Series Analysis*, Addison Wesley.

Reference Book

Lennard Ljung, *System Identification Theory for the User*, Information Science Series - Prentice Hall,

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

GLOBAL ELECTIVES

AI09 L24: Mobile Communications

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objective

To introduce the concepts of Mobile Communication Cellular environment

Module I (14 hours) Introduction to Cellular Mobile Systems

A basic cellular system, performance criteria, uniqueness of mobile environment, operation of cellular systems, planning a cellular system, analog and digital cellular systems
Elements of Cellular radio system design – concept of frequency reuse channels – co – channel interference reduction factor – desired C/I from a normal case in an omni directional antenna system – cell splitting –

Module II (16 hours) Cell coverage for Signal and Traffic

General introduction - mobile point to point mode – radio propagation characteristics : models for path loss – shadowing and multipath fading – propagation over water or flat open area – foliage loss – propagation in near distance – long distance propagation – cell site – antenna heights and signal coverage cells – mobile to mobile propagation

Module III (12 hours) Frequency management, Channel assignment and handoff

Frequency managemnt – fixed channel assignment – non fixed channel assignment – traffic and channel assignment – why handoff - types of handoff and their characteristics – handoff analysis

Module IV(12 hours) Multiple access techniques

FDMA/TDMA – CDMA, FDM/TDM Cellular systems – cellular CDMA – soft capacity – Earlang capacity comparison of FDM/TDM systems and Cellular CDMA
GSM architecture – mobile management – network signalling – frequency allocation and control

Text Books

1. T.S.Rappaport, Wireless Communications : Principles and Practice, Second edition, PHI, 2003
2. G.L. Stuber, Principles of Mobile Communications, Kluwer Academic Press

Reference Books

1. Dr Kamilo Feher, Wireless and Digital Communications, PHI
2. R.Blake , Wireless Communication Technology, Thomas Delmar, 2003

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

AI09 L25: Probability and Random Processes

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objective

- *To impart knowledge on tools and skills in probability theory for solving engineering problems*

Module I (12 hours) Introduction to Probability Theory

Experiments – sample spaces and Events – axioms of Probability – Assigning Probabilities – joint and conditional probabilities –Baye's thorem – independence - Dicrete random variables – Bernoulli – Binomial – poisson - Geometric

Module II (14 hours) Random Variables, Distributions and density functions

The Cumulative distribution function - Probability density function – gaussian Random variable – Uniform random variable – exponential –Laplace – gamma – erlang –Chi – squared –Rayleigh – Rician -Cauchy

Module III (14 hours) Operations on a single Random Variable

Expected value of a random variable - expected values of functions of random variable – Moments – central moments – conditional expected values – probability generating functions –Moment generating functions

Module IV (14 hours) Random Processes

Definition and classification of Processes – Mathematical tools for studying random processes – stationary and ergodic random processes – Properties of the Auto correlation function – gaussian random processes- Definition and examples of Markov Processes - calculating transition and state probabilities in Markov chains

Text Books

1 Scott L. Miller,Donald G. Childers, Probability and Random Processes, Academic Press,2009

2 Jean Jacod, Philip Protter, Probability Essentials, Springer 2008

Reference Books

1 Peyton Z. Peebles, Probability, Random Variables and Random signal Principles, Tata McGraw – Hill Publishing Limited, New Delhi, 4TH Edition

2 X. Rong Li, Probability, Random Signals, and Statistics

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

BT 09 L23 BIONANOTECHNOLOGY

Teaching Scheme :

3hours lecture and 1 hour tutorial per week **Credits :4**

Objectives

- To impart basic ideas on nanoparticles
- To impart knowledge on the use of nanotechnology in biotechnology

Prerequisite: No prerequisite

Module – I

Introduction to Nanobiotechnology and Nanomedicine, Visualization and Manipulation on Nanoscale. Atomic Force Microscopy, Magnetic Resonance Force Microscopy, Scanning Probe Microscopy, Nanoscale Scanning Electron Microscopy, Optical Imaging with a Silver Superlens.

Module – II

QuantumDots, Gold Nanoparticles, Lipoparticies, Assembly of Nanoparticles into Micelles, Biomedical Applications of Self-Assembly of Nanoparticles, Paramagnetic and Superparamagnetic Nanoparticles, Fluorescent Nanoparticles.

Module – III

Bacterial Structure Relevant to Nanobiotechnology, Cubosomes, Dendrimers, DNA-Nanoparticle Conjugates, DNA Octahedron, Fullerenes, Nanoshells, Carbonnnn Nanotubes, Nanopores, Nano structured Sillicon.

Module – IV

Molecular Motors, Nano particles for Molecular Diagnostics, Nano biosensors, Nanopharmaceuticals, Nanoparticle – Based Drug Delivery, Nanostructures for Tissue Engineering/Regenerative. Medicine, Ethical Safety, and Regulatory issues of Nanomedicine.

References

1. Nanobiotechnology: Bioinspired Devices and Materials of the Future: Oded Shoseyov and llan Levy.
2. Nanomaterials and Nanosystems for Biomedical Applications: M.Reza Mozafari.
3. The Handbook of Nanomedicine, Kewal K.Jain
4. Bio Nanotechnology, Elisabeth S.Pappazoglou, Aravind Parthasarathy
5. Biomedical Nanostructures, Kenneth E.Goonsalves, Craig R.Halberstadt, Cate T. Laurecin, Lakshmi S.Nair.

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

CS09 L24: Computer Based Numerical Methods

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To impart the basic concepts of mathematical modelling of problems in science and engineering and to know procedures for solving different kinds of problems.*
- *To understand the various numerical techniques which provide solutions to non linear equations, partial differential equations etc that describe the mathematical models of problems.*

Module I (13 hours)
Errors in numerical computation - mathematical preliminaries - errors and their analysis - machine computations - computer software. Algebraic and Transcendental Equations - bisection method - iteration method - method of false position - rate of convergence - method for complex root - Muller's method - quotient difference method - Newton-Raphson method.

Module II (13 hours)

Interpolation – introduction - errors in polynomial interpolation - finite differences - decision of errors - Newton's formula for interpolation. Gauss, Sterling, Bessel's, Everett's Formula - interpolation by unevenly spaced points - Lagrange interpolation formula - divided difference - Newton's general interpolation formula.

Module III (13 hours)

Numerical Integration and Differentiation – introduction - numerical differentiation - numerical integration - trapezoidal rule - Simpson 1/3 rule - Simpson 3/8 rule - Boole's and Weddle's rules - Euler-Maclariaun formula - Gaussian formula - numerical evaluation of singular integrals.

Module IV (13 hours)

Statistical Computations - frequency Chart - method of least square curve fitting procedures - fitting a straight line - curve fitting by sum of exponential - data fitting with cubic splines - approximation of functions. Regression Analysis - linear and nonlinear regression - multiple regression - statistical quality control methods.

Text Books

1. E. Balagurusamy, *Numerical Methods*, Tata McGraw-Hill Pub.Co.Ltd, New Delhi, 1999.
2. C.F. Gerald and P.O. Wheatley, *Applied Numerical Analysis, 6th Ed.*, Pearson Education Asia, New Delhi, 2002.

Reference Books

1. P. Kandasamy, K. Thilagavathy and K. Gunavathy, *Numerical Methods*, S.Chand Co. Ltd., New Delhi, 2003.
2. R.L. Burden and T.D. Faires, *Numerical Analysis, 7th Ed*., Thomson Asia Pvt. Ltd., Singapore, 2002.
3. Shastri, *Introductory methods of numerical analysis*, Prentice Hall International.
4. V. Rajaraman, *Introduction to Numerical Methods*, Tata McGraw Hill.

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

CS09 L25: Pattern Recognition

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To impart a basic knowledge on pattern recognition and to give a sound idea on the topics of parameter estimation and supervised learning, linear discriminant functions and syntactic approach to PR.*
- *To provide a strong foundation to students to understand and design pattern recognition systems.*

Module I (12 hours)

Introduction - introduction to statistical - syntactic and descriptive approaches - features and feature extraction - learning - Bayes Decision theory - introduction - continuous case - 2-category classification - minimum error rate classification - classifiers - discriminant functions - and decision surfaces - error probabilities and integrals - normal density - discriminant functions for normal density

Module II (12 hours)

Parameter estimation and supervised learning - maximum likelihood estimation - the Bayes classifier - learning the mean of a normal density - general bayesian learning - nonparametric technic - density estimation - parzen windows - k-nearest neighbour estimation - estimation of posterior probabilities - nearest-neighbour rule - k-nearest neighbour rule

Module III (12 hours)

Linear discriminant functions - linear discriminant functions and decision surfaces - generalised linear discriminant functions - 2-category linearly separable case - non-separable behaviour - linear programming procedures - clustering - data description and clustering - similarity measures - criterion functions for clustering

Module IV (16 hours)

Syntactic approach to PR - introduction to pattern grammars and languages - higher dimensional grammars - tree, graph, web, plex, and shape grammars - stochastic grammars - attribute grammars - parsing techniques - grammatical inference

Text Books

1. Duda & Hart P.E, *Pattern Classification And Scene Analysis*, John Wiley
2. Gonzalez R.C. & Thomson M.G., *Syntactic Pattern Recognition - An Introduction*, Addison Wesley.

Reference Books

1. Fu K.S., *Syntactic Pattern Recognition And Applications*, Prentice Hall, Eaglewood cliffs
2. Rajjan Shinghal, *Pattern Recognition: Techniques and Applications*, Oxford University Press, 2008.

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

AN09 L25 RESEARCH METHODOLOGY

Teaching scheme

3 hours lecture and 1 hour tutorial per week **credits 4**

Objective

To give an exposure to the major aspects of research and research approaches.

MODULE 1 (13hours)
Introduction – meaning of research- objectives of research-motivation in research- types of research-research approaches – significance of research- research methods Vs methodology – criteria for good research

MODULE 2(14hours)
Defining research problem- what is a research problem- selecting the problem- necessity of defining the problem- literature review – importance of literature review in defining a problem-critical literature review – identifying gap areas from literature review

MODULE 3 (14hours)
Research design–meaning of research design-need–features of good design- important concepts relating to research design- different types – developing a research plan
Method of data collection–collection of data- observation method- interview method-questionnaire method – processing and analyzing of data- processing options- types of analysis-interpretation of results

MODULE 4 (13hours)
Report writing – types of report – research report , research proposal, technical paper- significance-different steps in the preparation – lay out, structure and language of typical reports- simple exercises - oral presentation – planning, preparation, practice- making presentation – answering questions-use of visual aids-quality and proper usage-Importance of effective communication with illustrations.

Reference books

1. Coley.S.M and Scheinberg C.A 1990 , *Proposal writing*, Newbury-Sage Publications.
2. Leedy.P.D, *Practical research planning and Design*, 4th edition ,MW Macmillan publishing company.
3. Day Ra,1989 "*How to write and publish a scientific paper*", Cambridge University Press .
4. Earl Babbie,1994, *The practice and Social Research*,Wordsworth Publishing Company,
5. J.H. Ansari, Mahavir – ITPI Reading Material on Planning Techniques

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

PART A: Short answer questions (one/two sentences)
5 x 2 marks=10 marks

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions
4 x 5 marks=20 marks

Candidates have to answer

IT09 L23: DISTRIBUTED SYSTEMS

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *The development of distributed systems followed the emergence of high-speed local area networks, the availability of high performance PCs, workstations and servers has resulted in a recent shift towards distributed systems, and away from centralized, multi user systems. This trend has been accelerated by the development of distributed system software designed to support the development of distributed applications.*
- *This course is to impart basic knowledge of the issues concerning distributed systems, from both software and hardware viewpoints.*

Module - I: (10 hours)
Operating system fundamentals - distributed system concepts and architectures - major design issues - distributed computing environments (DCE)

Module - II: (13 hours)
Concurrent processes and programming - threads and processes - client server model - time services language mechanisms for synchronization - concurrent programming languages

Module - III: (13 hours)
Interprocess communication and coordination - message passing communication - request/reply communication - transaction communication - name and directory services - distributed mutual exclusion - leader election

Module - IV: (16 hours)

Distributed process scheduling - static process scheduling, dynamic load sharing and balancing - distributed process implementation - real-time scheduling - concepts of distributed file systems - distributed shared memory - distributed computer security

Text Books

1. Chow R & Johnson T, *Distributed Operating Systems and Algorithms*, Addison Wesley.

Reference Books

1. Sinha P.K, *Distributed Operating Systems Concepts and Design*, PHI.
2. Tanenbaum S, *Distributed Systems Concepts And Design*, Prentice Hall Inc.
3. Coulouris G., Dollimore J. & Kindberg T, *Distributed Systems Concepts And Design*, Addison Wesley.
4. Singhal M. & Shivaratri, *Advanced Concepts In Operating Systems, Distributed Databases and Multiprocessor Operating Systems*, McGraw Hill.

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

IT09 L24: MANAGEMENT INFORMATION SYSTEMS

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *This course will introduce the methods and the influence of the information systems in management milieu and use MIS as an effective tool in management and decision making.*

Module - I: (12 hours)
Information systems - functions of management - levels of management - framework for information systems - systems approach - systems concepts - systems and their environment - effects of system approach in information systems design - using systems approach in problem solving - strategic uses of information technology

Module - II: (10 hours)
An overview of computer hardware and software components - file and database management systems - introduction to network components - topologies and types - remote access - the reasons for managers to implement networks - distributed systems - the internet and office communications

Module - III: (14 hours)
Application of information systems to functional - tactical and strategic areas of management, decision support systems and expert systems

Module - IV: (16 hours)
Information systems planning - critical success factor - business system planning - ends/means analysis - organizing the information systems plan - systems analysis and design - alternative application development approaches - organization of data processing - security and ethical issues of information systems

Text Books

1. Robert Schultheis & Mary Sumner, *Management Information Systems-The Manager's View*, Tata McGraw Hill.

Reference Books

1. Laudon K.C. & Laudon J.P, *Management Information Systems - Organization and Technology*, Prentice Hall of India
2. Sadagopan S, *Management Information Systems*, Prentice Hall of India
3. Basandra S.K, *Management Information Systems*, Wheeler Publishing.
4. Alter S, *Information Systems: A Management Perspective*, Addison Wesley.
5. Effy Oz, *Management Information Systems*, Thomson Vikas Publishing House

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

PE09 L23: Total Quality Management

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To impart knowledge on the concept of quality tools for analysing quality statistical tools in quality acceptance sampling life tests*

Module I (14 hours)
Definition of quality-internal and external customers- vision statement – mission statements – objectives – goals – targets- evolution of TQM – Defining TQM – stages in TQ M implementation-TQM models

Module II (14 hours)
SWOT analysis-strategic planning-customer focus-quality function deployment-customer satisfaction measurement-seven new management tools-Deming wheel-zero defect concept-bench marking-six sigma concepts-failure mode and effect analysis-poke yoke

Module III (13 hours)
Five S for quality assurance-quality circle philosophy-failure rate analysis-mean failure rate-mean time to failure (MTTF)-Mean time between failure (MTBF)-hazard models-system reliability-availability-maintenance

Module IV (13 hours)
Quality and cost-characteristics of quality cost-micro analysis of quality cost-measurement of quality-TQM road map- ISO 9000 series certification-ISO 9001:2000 certification-ISO 14000 certification-QS 9000 auditing-Quality auditing- quality awards

Text Books

1. L Suganthi, Anand A Samuel, *Total Quality Management*, PHI
2. Lt.Gen. Lal H, *Total Quality Management*, Wiley Eastern Limited

Reference Books

1. Greg Bounds, *Beyond Total Quality Management*, McGraw Hill Publishers
2. Menon H G, *TQM in New Product Manufacturing*, McGraw Hill Publishers

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

PE09 L25: Entrepreneurship

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To give an idea on entrepreneurial perspectives*

Module I (14 hours)
Entrepreneurial perspectives- understanding of entrepreneurship process- entrepreneurial decision process- entrepreneurship and economic development- characteristics of entrepreneur- entrepreneurial competencies- managerial functions for enterprise.

Module II (14 hours)
Process of business opportunity identification and evaluation- industrial policy- environment- market survey and market assessment- project report preparation-study of feasibility and viability of a project- assessment of risk in the industry

Module III (13 hours)
Process and strategies for starting venture- stages of small business growth- entrepreneurship in international environment- entrepreneurship- achievement motivation- time management creativity and innovation structure of the enterprise- planning, implementation and growth

Module IV (13 hours)
Technology acquisition for small units- formalities to be completed for setting up a small scale unit- forms of organizations for small scale units-financing of project and working capital-venture capital and other equity assistance available- break even analysis and economic ratios technology transfer and business incubation

Text Books

1. Harold Koontz & Heinz Weihrich, *Essentials of Management*, McGraw hill International
2 Hirich R.D. &Peters Irwin M.P., *Entrepreneurship*, McGraw Hill
3. Rao T.V., Deshpande M.V., Prayag Mehta &Manohar S. Nadakarni, *Developing Entrepreneurship a Hand Book*, Learning systems
4. Donald Kurado & Hodgelts R.M., *Entrepreneurship A contemporary Approach*, The Dryden Press
5. Dr. Patel V.G., *Seven Business Crisis*, Tata McGraw hill
   Timmons J.A., *New venture Creation- Entrepreneurship for 21st century*, McGraw Hill International
6. Patel J.B., Noid S.S., *A manual on Business Oppurnity Identification*, selections, EDII
7. Rao C.R., *Finance for small scale Industries*
8. Pandey G.W., *A complete Guide to successful Entrepreneurship*, Vikas Publishing

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: *Short answer questions (one/two sentences)* *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical/Problem solving questions* *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions* *4 x 10 marks=40 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 70