

BE BIOMEDICAL ENGINEERING

SEMESTER - 1

19D101 CALCULUS AND ITS APPLICATIONS

3 1 0 4

DIFFERENTIAL CALCULUS : Functions of two variables, limit, continuity, partial derivatives, differentiability, total differential, extreme values and saddle points, constrained maxima and minima, Lagrange multipliers with single constraint, Taylor's formula for two variables. (9 + 3)

MULTIPLE INTEGRALS I : Basic concepts, double integrals over rectangles, double integrals as volumes, Fubini's theorem, double integrals over general regions, area by double integration, reversing the order of integration. (9 + 3)

MULTIPLE INTEGRALS II : Double integrals in polar form, triple integrals in rectangular coordinates, spherical and cylindrical coordinates. (9 + 3)

SECOND ORDER LINEAR ORDINARY DIFFERENTIAL EQUATIONS : Homogeneous linear ODEs of second order, linearity principle, general solution, homogeneous linear ODEs with constant coefficients, Euler–Cauchy equations, solution by variation of parameters, modeling of electric circuits. (9 + 3)

VECTOR CALCULUS : Gradient of a scalar field, directional derivative, divergence of a vector field, curl of a vector field. Integration in vector field — line integrals, Green's, Gauss divergence and Stokes's theorems. (9 + 3)

Total L: 45 +T: 15 = 60

TEXT BOOKS:

1. Joel Hass, Christopher Heil, Maurice D.Weir "Thomas' Calculus", Pearson Education, New Delhi, 2018
2. Erwin Kreyszig "Advanced Engineering Mathematics", Wiley India Pvt Ltd., New Delhi, 2015

REFERENCES:

1. J.E.Marsden, A.J.Tromba, A. Weinstein "Basic Multivariable Calculus", Springer Verlag, New York, 2019
2. Howard Anton, Irl Bivens, Stephen Davis "Calculus", John Wiley & Sons, Inc, USA, 2016
3. Wylie C R and Barrett L C "Advanced Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2019
4. James Stewart "Multivariable Calculus", Brooks Cole, USA, 2012

19D102 INTRODUCTION TO ELECTROMAGNETIC THEORY

3 0 0 3

ELECTRIC CHARGE, FORCE & FIELD : Electric charge, Coulomb's laws, Electric field, Fields of charge distributors, Matters in Electric field: Point charge, dipoles, Conductors, Insulators & dielectrics. Gauss law: Electric field lines, Electric flux and field, Gauss law, Fields of Arbitrary charge distribution, Field at a conductor surface. Applications: Microwave cooking, Liquid Crystals, Shielding and Lightning Safety. (9)

ELECTRIC POTENTIAL : Electric potential difference, curved paths and non uniform fields. Calculating potential difference: potential of a point charge, zero potential, finding potential differences using superposition. Potential difference and Electric field, charged conductors. Electrostatic Energy, Capacitors, Energy in the Electric field. Applications: Corona discharge, pollution control and xerography. (9)

MAGNETISM : Magnetic force and field, Charged particles in magnetic fields, Magnetic force on a current, Hall effect. Biot-Savart's law, Magnetic force between conductors. Magnetic dipoles, Gauss's law of magnetism, Torque on a magnetic dipole. Ampere's law, Magnetic field due to straight conductors, circular loop — Magnetic flux density(B), Magnetic potential. (9)

ELECTROMAGNETIC INDUCTION : Induced currents, Faraday's law, Induction and Energy, motional emf and Lenz's law, Electromagnetic braking and its applications. Eddy currents, closed and open circuits in magnetic field. Inductance: mutual and self inductance. Magnetic energy, Induced electric fields: conservative and non conservative electric fields. (9)

MAXWELL'S EQUATIONS AND ELECTROMAGNETIC WAVES : Ampere's law - modification. Maxwell's equations, electromagnetic waves, Properties of electromagnetic waves, Electromagnetic spectrum, Electromagnetic waves propagation through isotropic media. (9)

Total L: 45

TEXT BOOKS:

1. Richard Wolfson "Essential University Physics", Pearson, 2011
2. David J Griffiths "Introduction to Electrodynamics", Pearson, 2015

REFERENCES:

1. D Halliday and R Resnick "Fundamentals of Physics", John Wiley and Sons, 2015
2. Richard P Feynman, Robert B Leighton "The Feynman Lectures on Physics", Addison-Wesley, 2011
3. Gaur R K, Gupta S L "Engineering Physics", Dhanpat Rai publications, 2013
4. Raymond A. Serway, John W. Jewett "Physics for Scientist and Engineers", Cenagage Learning, 2010

19D103 CHEMISTRY OF ELECTRONIC MATERIALS**3 0 0 3**

CONDUCTING PROPERTIES OF MATERIALS : Molecular orbital treatment of bonding in metals, insulators, semiconductors — direct band and indirect band, elemental, p-doped, n-doped, stoichiometric compound semiconductors and chalcogen semiconductors. Crystal defects and their influence on properties of materials — intrinsic defects - schottky and frenkel, non-stoichiometric compounds, extrinsic defects - oxide ion conductors - applications. Nanoscale materials – Quantum dots-band gap – size dependant optical properties. (9)

POLYMERIC MATERIALS : Classification, degree of polymerization, average molecular weights, polydispersity. Polymerization reactions — chain and condensation. Thermal properties -glass transition temperature(Tg) — factors affecting Tg - determination by DSC. Mechanical properties — significance in fabrication of electronics. Electrical insulating properties - dielectric breakdown - aging of polymer insulations - discharges in voids, electrical treeing. Thermal and photochemical degradations. Additives - plasticisers, stabilisers, functional additives. (9)

FLEXIBLE ELECTRONIC MATERIALS : Conjugated polymers — electronic energy bands - mechanism of charge transport — intrachain and interchain - solitons, polarons and bipolarons. Factors influencing charge transport — structural features - defects, molecular weight, crystalline/amorphous nature, doping- oxidative and reductive. Synthesis, properties and applications of polyaniline, polythiophene and polypyrrole. Molecular electronics - graphene, fullerenes, carbon nanotubes – structure, synthesis, properties and applications. (9)

OPTOELECTRONIC MATERIALS : Electroluminescence- exciton, OLED materials– emitters- charge transfer complexes, metal chelates, polycyclic aromatic oligomers, conjugated polymers — polyphenylenes, polyfluorenes. Liquid crystalline polymers- classification of liquid crystals, chemical constitution, stability and applications. Organic and dye sensitized photovoltaics — working principle, materials, advantages and disadvantages. Preparation of ultrathin polymer films - Langmuir-Blodgett Films –self assembled monolayers. (9)

MATERIALS FOR ELECTRONICS PROCESSING : Semiconductor wafer fabrication -Overview and challenges –high purity chemicals, air filters for clean rooms, electronic grade water- quality parameters, water treatment stages for ultrapure water production — membranes and ion-exchange resins, electro dialysis. Photoresists for wafer fabrication — microlithography, resist requirements, material chemistry. Electronic packaging materials-adhesives, connectors, eutectic alloys, phase change materials-phase diagrams, applications. (9)

Total L: 45**TEXT BOOKS:**

1. Lesley E. Smart, Elaine A. Moore "Solid State Chemistry - an Introduction", CRC Press, London, 2005, fourth edition
2. Cowie J.M.G, Valeria Arrighi "Polymers: Chemistry and Physics of modern materials", CRC Press, London 2007.

REFERENCES:

1. Bansi D. Malhotra "Handbook of Polymers in Electronics", Rapra Technology Ltd., UK, 2002, first edition
2. Stergios Logothetidis "Handbook of Flexible Organic Electronics Materials - Manufacturing and Applications", Wood Head publishing, London, 2015, first edition
3. Peter Van Zant "Microchip Fabrication: A Practical Guide to Semiconductor Processing", Mc Graw Hill, 2014, sixth edition
4. Shashi Chawla "A Textbook of Engineering Chemistry", Dhanpat Rai and Co, New Delhi, 2005 , first edition

19D104 BASICS OF ELECTRICAL ENGINEERING**3 1 0 4**

INTRODUCTION TO DC AND AC CIRCUITS : Electric quantities: Potential - Current - Energy and Power, Circuit laws: Ohm's law - Kirchhoff's law, Circuit elements: Resistor, Inductor and Capacitor, Ideal independent current and voltage sources, Circuit symbols, Alternating quantities: Sinusoidal voltage and current - Average value - RMS value - Power factor - Phasor representation - Introduction to three phase systems. (12 + 3)

NETWORK THEOREMS : Thevenin's theorem, Norton's theorem, Superposition theorem, Maximum Power Transfer theorem, Compensation theorem, Reciprocity theorem. (6 + 3)

DC MACHINES : Types of dc motors, Construction and Principle of operation: Shunt motor - Series motor - Compound motor, Speed-torque characteristics, Starting, Speed control, Braking. (9 + 3)

AC MACHINES : Types of AC motors, Construction and principle of operation: Single phase induction motor - Three phase induction motor - Synchronous motor, Speed-torque characteristics, Starting, Speed control, Braking, Transformers: Types - Construction - EMF equation. (9 + 3)

SPECIAL MACHINES : Stepper motor: Types — Construction — Principle of Operation — Characteristics - Control circuits - Applications, Servo Motor: Servo types — Servomechanism — Principle of operation - Control circuits — Applications, Brushless DC Motor, Switched reluctance Motor (9 + 3)

Total L: 45 +T: 15 = 60

TEXT BOOKS:

1. Mittle V V, Aravind Mittal "Basics of Electrical Engineering", Tata McGraw Hill, New Delhi, 2017
2. Vincent Del Toro "Electrical Engineering Fundamentals", Pearson education, New Delhi, 2015

REFERENCES:

1. Charles Alexander, Mathew Sadiku "Fundamentals of Electric Circuits", Tata McGraw Hill, New Delhi, 2010
2. Gupta B R, Vandana Singhal "Fundamentals of Electrical Machines", New Age International Publishers, New Delhi, 2005
3. Sudhakar A, Shyammoan S P "Circuits and Networks", Tata McGraw Hill, New Delhi, 2010
4. Fitzgerald A E, Charles Kingsley Jr, Stephen D, Umans "Electric Machinery", McGraw-Hill Higher Education, New York, 2010

19G105 ENGLISH LANGUAGE PROFICIENCY

2 1 0 3

LEARNING LANGUAGE THROUGH STANDARD LITERARY AND GENERAL TEXTS : Integrated tasks focusing on language skills ; Training based on Text based vocabulary, tone, register and Syntax features (12 + 0)

GRAMMAR IN CONTEXT : Word Order ; Subject Verb Concord ; Style features - Tenses, Conditionals, Prepositions, Active and Passive Voice, Modals, Cloze and Spotting Error exercises (10 + 0)

GUIDELINES FOR WRITTEN COMMUNICATION : Principles of clear writing, Paragraph writing, Essay writing, Emphasis Techniques, Summarizing and Paraphrasing, Analytical writing. (8 + 0)

FOCUS ON SPOKEN ENGLISH : Task — based activities: Graded levels of difficulty and with focus on language functions - Level 1: Self — expression — Greetings in Conversation, Hobbies, Special interests, Daily routine - Level 2: General Awareness — Expression of Concepts, Opinions, Social Issues, Description of a process / picture/chart, news presentation / review - Level 3: Advanced Skills — Making Short Speeches and Participating in Role Plays. (0 + 10)

LISTENING ACTIVITY : Task based activities using Language Laboratory (0 + 5)

Total L: 30 +T: 15 = 45

TEXT BOOKS:

1. Faculty Incharge "Course Material on "English Language Proficiency", PSG College of Technology, Coimbatore, 2019

REFERENCES:

1. Jill Singleton "Writers at Work: The Paragraph", Cambridge University Press, New York, 2012
2. Simon Haines, Mark Nettle and Martin Hewings "Advanced Grammar In Use", Cambridge University Press, New Delhi, 2008
3. Anne Laws "Writing Skills", Orient Black Swan, Hyderabad, 2011
4. Sinha DK "Specimens of English Prose", Orient Black Swan, Hyderabad, 2012

19D110 ENGINEERING GRAPHICS

0 0 4 2

INTRODUCTION TO ENGINEERING DRAWING :

Drawing instruments, standards and conventions , principles of lines Lettering Rules and problems on dimensioning. (12)

PICTORIAL PROJECTION :

Principles, Projection of points straight lines planes and solids. (12)

ORTHOGRAPHIC PROJECTION :

Principles of pictorial views, Orthographic views from given pictorial views.

(12)

SECTIONS OF SOLIDS :

Types of sections, Selection of section views, Sectional views of simple engineering components.

(12)

COMPUTER AIDED DESIGN :

Computer aided design Software Lettering and Dimensioning with CAD Selection of Drawing Sheet Size and Scale Simple drawing using CAD.

(12)

Total P: 60**TEXT BOOKS:**

1. Luzadder , Duff "Fundamentals of Engineering Drawing", Prentice Hall of India Pvt. Ltd, New Delhi, 2015
2. Venugopal K , Prabhu Raja V. "Engineering Graphics", New Age International Publishers, New Delhi, 2017

REFERENCES:

1. Natarajan K. V "Engineering Drawing and Graphics", Dhanalakshmi Publishers, Chennai, 2018
2. Cencil jenson, Jay D. Helsel, Dennis R. short "Engineering Drawing and Design", McGraw Hill publishers, New Delhi, 2017

19D111 ENGINEERING PRACTICES**0 0 2 1****MODULE I :**

Study of different types of electronic components (resistors, capacitors, inductors etc), CRO, analog and digital multimeter, function generator and DC power supply, Preparation of PCB layout and fabrication of PCB (Printed circuit board) Soldering of components on the fabricated PCB and testing of PCB, Study of House wiring and construction, working of various motors, Study of different types of lamps (CFL lighting, LED lighting, flood lighting, multi-arm fitting) — Measurement of power.

MODULE II :

Welding - Metal arc welding tools and equipment, exercises by Arc welding and TIG welding Processes Fitting - Tools, operations, exercises Make "T"-Joint and "L" Joint, types of joints Carpentry- Tools, carpentry process, carpentry exercises, types of joints Plumbing-exercises-external thread cutting and joining Sheet metal work & Soldering - Tools, operations, exercises, Make a Rectangular Tray in Galvanized Iron sheet

Total P: 30**19D112 ELECTRICAL LABORATORY****0 0 2 1****LIST OF EXPERIMENTS :**

1. Study of Analog and Digital Oscilloscope
2. Measurement of DC quantities
3. Measurement of AC quantities
4. Verification of Kirchhoff's Voltage and Current law
5. Verification of Thevenin's theorem
6. Verification of Norton's theorem
7. Experimental verification of Superposition theorem
8. Simulation and experimental verification of Maximum power transfer theorem
9. Speed control of DC motor
10. Open circuit and Short circuit test on transformer

Total P: 30**19IP15 INDUCTION PROGRAMME****0 0 0 0**

As per AICTE guidelines

SEMESTER - 2

19D201 COMPLEX VARIABLES AND TRANSFORMS

3 1 0 4

COMPLEX DIFFERENTIATION : Complex differentiation - analytic function, Cauchy-Riemann equations, harmonic functions, linear fractional transformations. (9 + 3)

COMPLEX INTEGRATION : Cauchy's integral theorem, Cauchy's integral formula, Laurent series, singularities and zeros, residue integration method (Residue integration of complex integrals only). (9 + 3)

LAPLACE TRANSFORMS : Laplace transform, inverse transform, linearity, s-shifting, transforms of derivatives and integrals, unit step function, t - shifting, Dirac's delta function, periodic functions, method of solving differential equations by using Laplace transform technique. (9 + 3)

FOURIER SERIES : Fourier series- convergence and sum of Fourier series, functions of any period $2L$, even and odd functions, half range expansions. (9 + 3)

FOURIER TRANSFORMS : Fourier transform, Fourier cosine and sine transforms, Discrete Fourier transform, Fast Fourier transform—DITalgorithm. (9 + 3)

Total L: 45 +T: 15 = 60

TEXT BOOKS:

1. Erwin Kreyszig "Advanced Engineering Mathematics", John Wiley & Sons, New Delhi, 2015
2. Wylie C. R. and Barrett L. C "Advanced Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2019

REFERENCES:

1. Mathews J. H. and Howell R. W "Complex Analysis for Mathematics and Engineering", Narosa Publishing House, New Delhi, 2012
2. Peter V.O Neil "Advanced Engineering Mathematics", Cengage, New Delhi, 2016
3. Dennis G Zill "Advanced Engineering Mathematics", Jones & Bartlett India Pvt Ltd, New Delhi, 2017
4. Dean G Duffy "Advanced Engineering Mathematics with MATLAB", CRC, USA, 2017

19D202 BIOMATERIALS

2 0 0 2

STRUCTURE AND PROPERTIES OF MATERIALS : Atomic and molecular bonds, crystal structure of solids, phase changes, crystal imperfections, non crystalline solids, surface properties, mechanical properties, thermal treatments, surface improvements. (6)

METALLIC BIOMATERIALS : Stainless steel, cobalt chromium alloys, titanium based alloys, nitinol, other metals, metallic corrosion, biological tolerance of implant metals, manufacturing of implants, dental materials. (5)

CERAMIC BIOMATERIALS : Relatively bioinert bioceramics, biodegradable ceramics, surface reactive or bioactive ceramics, composites, analysis of ceramic surfaces, deterioration of ceramics, manufacturing technique. (5)

SYNTHETIC AND BIOPOLYMERS : Polymers in biomedical use, biodegradable synthetic polymers, silicone rubber, plasma polymerization, microorganism in polymeric implants, bio polymers, polymer sterilization. (6)

BIO-COMPATIBILITY TESTING : Concept of biocompatibility — Cell-material interactions and foreign body response Assessment of biocompatibility of biomaterials, in vivo testing and histocompatibility assessment, Genotoxicity assessment. Sterilization techniques – steam and radiations. (8)

Total L: 30

TEXT BOOKS:

1. Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons "Biomaterial Science; An Introduction to Materials in Medicine", Elsevier Academic Press, 2013
2. Joon B Park, Joseph D Bronzino "Biomaterials Principles and Applications", CRC press, London, 2003

REFERENCES:

1. Sujata V Bhat "Biomaterials", Narosa Publishing House New Delhi, 2005

2. Severian Dumitriu "Polymeric Biomaterials", Marcel Dekker, Inc., New York, 2013
3. William D Callister Jr. "Material Science and Engineering", John Wiley and sons, New York, 2006
4. Joseph D, Bronzino, Donald R. Peterson "The biomedical engineering handbook", CRC Press Taylor and Francis, 2015.

19D203 CHEMISTRY FOR BIOMEDICAL ENGINEERING

2 0 0 2

BIOMOLECULES – TYPES AND STRUCTURE : Carbohydrates, Lipids, Proteins, Enzymes and Nucleic acids —Chemical composition, structure, chemical and physical properties, classification and types. (6)

BIOMOLECULES - METABOLISM : Carbohydrate metabolism — glycolysis and TCA cycle. Fatty acid metabolism - β oxidation. Amino acid oxidation and urea cycle. Nucleotide metabolism. (6)

OPTICAL SPECTROSCOPY : UV-Visible spectroscopy - Beer-Lambert law, instrumentation, applications. Fluorescence spectroscopy — fluorescence intensity and anisotropy. IR spectroscopy- selection rules, finger print regions, common functional group frequencies, Circular dichroism — principle, instrumentation, application. Raman spectroscopy — selection rules, applications. Optical labels for biomedical applications. (6)

NMR AND MASS SPECTROSCOPY : Nuclear magnetic resonance spectroscopy - chemical shifts, spin-spin splitting, spectral pattern in small molecules. MRI — principle and contrast agents, biomedical applications. Mass spectrometry - base peaks, fragmentations, examples in biomolecules. (6)

SENSORS: Components of sensors, types of sensors — amperometric and potentiometric transducers. Electrochemical sensors - ion-selective electrodes, solid-state, pH, redox, gas electrodes, membrane electrodes. Glucose biosensors. Bioreceptors. (6)

Total L: 30

TEXT BOOKS:

1. Cox M. M. and Nelson D. L Lehninger, "Principles of Biochemistry", W H Freeman and Co., New York, 2011
2. Banwell C.N and, McCash E "Fundamental of Molecular Spectroscopy", Tata McGraw-Hill International Limited, New Delhi, 2008

REFERENCES:

1. Voet D, Voet J. G, Pratt C. W "Fundamentals of Biochemistry: Life at the Molecular Level", John Wiley & Sons, New Jersey, 2006
2. Mikkelsen M. R and Corton. E "Bioanalytical Chemistry", Wiley India Private Limited, Noida, 2016
3. Harsanyi G "Sensors in Biomedical applications", CRC Press, London, 2000
4. William Kemp "Organic Spectroscopy", Palgrave Publishers Limited, New York, 1991

19D204 ELECTRON DEVICES

3 0 0 3

SEMICONDUCTOR DIODES : Semiconductor theory - PN Diode: Biasing , Characteristics , Equivalent circuits , Applications: Rectifiers , Diode limiting and clamping circuits - Special purpose diodes: Zener diodes , Varactor diodes , Photo diodes. (9)

BIPOLAR JUNCTION TRANSISTORS : Transistor structure and operation - Transistor characteristics and parameters - Transistor as an amplifier - Transistor as a switch - Transistor bias circuits - BJT amplifier configuration: Common emitter, Common base , Common collector amplifiers - Frequency response of BJT amplifier. (9)

FIELD EFFECT TRANSISTORS : JFET: Characteristics , Parameters , Biasing - MOSFET: Enhancement MOSFET , Depletion MOSFET , Characteristics , Parameters , Biasing - FET as an amplifier - Amplifier configuration: Common source , Common gate , Common drain types - Frequency response of FET amplifier. (9)

FEEDBACK AMPLIFIERS AND OSCILLATORS : Feedback concepts - Advantages of negative feedback - Voltage/Current feedback - Series/Shunt feedback - Oscillators: Positive feedback , Barkhausen criterion for oscillation , RC Phase shift , Wein Bridge , Hartley , Colpitts , Crystal oscillators. (9)

POWER ELECTRONICS : Power amplifiers: Class A, Class B , Class AB , Class C power amplifiers - SCR - TRIAC - DIAC - UJT - Voltage regulators: Series Voltage regulators , Shunt Voltage regulators - Power supplies. (9)

Total L: 45

TEXT BOOKS:

1. Thomas L Floyd "Electronic Devices", Pearson Education Limited, United Kingdom, 2018
2. Robert L Boylestad, Louis Nashelsky "Electronic Devices and Circuit Theory", Pearson, Chennai, 2016

REFERENCES:

1. David A Bell "Electronic Devices and Circuits", Oxford University Press, New Delhi, 2016
2. Jacob Millman, Christos C Halkias, SatyabrataJit "Millman's Electronic Devices and Circuits", McGraw Hill Education, New Delhi, 2016
3. Muhammad H Rashid "Power Electronics: Devices- Circuits and Applications", Pearson, Chennai, 2018
4. Adel S Sedra, Kenneth C Smith "Microelectronic Circuits: Theory and Applications", Oxford University Press, New Delhi, 2017

19D205 PROBLEM SOLVING AND C PROGRAMMING**2 0 0 2**

INTRODUCTION TO PROBLEM SOLVING : Analyzing and Defining the Problem - Algorithm - Flow Chart — Program development steps -Types of programming language. C: The C character set - Identifiers and keywords - Data types — Constants - Variables -Declarations -input and output functions-preprocessor directives. (3)

OPERATORS AND EXPRESSIONS : Arithmetic operators - Unary operators - Relational operators - logical operators - Assignment operators - Conditional operators - comma operator - size of operator -precedence and associativity- Library functions. CONTROL STATEMENTS: simple if, if..else, nested if .. else ,else if ladder , switch case - while -do while - for - Nested loops -break—continue—goto statements. (9)

ARRAYS : Defining an array - Processing an array - Multi dimensional arrays -strings. (6)

FUNCTIONS : Function prototype - Defining a function — function call - Passing arguments to a function —nested function — recursive function- Storage classes - auto - static - extern and register variables. (4)

STRUCTURES : Definitions - Processing a structure — Array and structures — Nested structures - Structures and functions.POINTERS: Definition - Pointer Arithmetic — types of pointer - const pointer, pointer to a constant, void pointer, null pointer (8)

Total L: 30**TEXT BOOKS:**

1. Deitel H. M. and Deitel P. J "C: How To Program", Prentice Hall of India, New Delhi, 2015
2. Ajay Mittal "Programming in C - A Practical approach", Pearson, New Delhi, 2010

REFERENCES:

1. Gottfried B "Programming with C", McGraw Hill Education, New Delhi, 2018
2. Herbert Schildt "C: The Complete Reference", McGraw Hill, New Delhi, 2017
3. Kernighan B. W. and Ritchie D. M "Programming Language (ANSI C)", Prentice Hall of India, New Delhi, 2013

19D211 PROBLEM SOLVING AND C PROGRAMMING LABORATORY**0 0 2 1**

1. Working with RAPTOR Tool — Flowchart Interpreter
2. Operators
3. Decision making Statements
4. Loops : while , do while, for
5. One dimensional array
6. Two dimensional array
7. Strings
8. Functions
9. Recursive functions
10. Structures
11. Structures and arrays
12. Nested Structures
13. Pointers

Total P: 30

REFERENCES:

1. Deitel H. M. and Deitel P "C: How To Program", Prentice Hall of India, New Delhi, 2015
2. Ajay Mittal "Programming in C - A Practical approach", Pearson, New Delhi, 2010
3. Gottfried B "Programming with C", McGraw Hill Education, New Delhi, 2018
4. Herbert Schildt "C: The Complete Reference", McGraw Hill, New Delhi, 2017

19D212 ELECTRON DEVICES LABORATORY**0 0 2 1****LIST OF EXPERIMENTS :**

1. Study of PSpice
2. Characteristics of PN diode and Zener diode
3. Construction and testing of clipper and clamper circuits
4. Construction and testing of rectifier circuits
5. Characteristics of photo diode
6. Frequency response characteristics of BJT
7. Characteristics of MOSFET
8. Construction and testing of wein bridge oscillator
9. Construction and testing of power amplifier
10. Construction and testing of voltage regulator

Total P: 30**19D213 BASIC SCIENCES LABORATORY****0 0 4 2****PHYSICS LIST OF EXPERIMENTS (ANY EIGHT) :**

1. Determination of Young's Modulus of a wooden bar — Cantilever method
2. Determination of magnetic field along the axis of a coil
3. Determination of Hysteresis loss of a ferromagnetic material
4. Determination of resistivity of metal and alloy using Carey Foster bridge
5. Determination of Temperature Coefficient of Resistance of metallic wire using post office box
6. Determination of capacitance using LCR bridge
7. Determination of lattice constant using X-ray powder photograph
8. Study of reverse bias characteristics of Germanium diode and determination of its band gap
9. Thermistor: Measurement of temperature and band gap
10. Hall effect - Determination of Hall Coefficient

(30)**CHEMISTRY (ANY EIGHT EXPERIMENTS) :**

1. Determination of molecular weight of polymers by Ostwald viscometer/Ubbelohde viscometer
2. Determination of total, temporary and permanent hardness of water by EDTA method
3. Determination of total, calcium and magnesium hardness of water by EDTA method
4. Lipid analyses: acid value, iodine number and saponification value
5. Determination of isoelectric point of an amino acid by pH metry
6. Estimation of amount of amino acid in given solution by Formol titration
7. Estimation of glucose present in given sample
8. Estimation of acids present in a mixture by conductometry method
9. Estimation of iron by potentiometry
10. Estimation of iron by photocolourimetry

(30)**Total P: 60****REFERENCES:**

1. Department of Physics "Physics Practicals", 2019
2. Wilson J. D. and Hernandez C. A. "Physics Laboratory Experiments", Houghton Mifflin Company, New York, 2009
3. Department of Chemistry "Chemistry Laboratory Manual", 2019

19D214 INTERNSHIP

0 0 0 2

UNIT I A: HISTORICAL PERSPECTIVE OF BIOMEDICAL ENGINEERING:

Industrial revolution , Contribution of instrumentation to development of Biomedical Technology — Design and building of precision measuring devices , Hospital layout- Organization structure- Departments in a hospital.

UNIT I B: VISIT TO VARIOUS DEPARTMENTS OF HOSPITALS AND RESEARCH FACILITIES AT THE INSTITUTION:

PSG IMSR- TIFAC - CORE - Nanotech Research Facility - PSG TI Centre of Excellence - Bio medical equipment calibration facility.

UNIT II A: TRAINING IN VIRTUAL INSTRUMENTATION:

Virtual Instrument ,Software overview, creating- editing- debugging and running a virtual instrument.

UNIT II B: TRAINING IN SPREADSHEET SKILLS:

Need for spread sheet in engineering- Methods of data entry- Conditional formatting- sorting and filtering- performing engineering calculations- Graphical analysis tools: Histogram- Bar chart- Pie chart- Line plot- Scatter plot.

UNIT III: SEMINAR PRESENTATION AND TECHNICAL REPORT WRITING:

Each student has to make one technical presentation and has to submit a technical report.

SEMESTER - 3

19D301 LINEAR ALGEBRA AND NUMERICAL ANALYSIS

3 1 0 4

VECTOR SPACE: General vector spaces, real vector spaces, Euclidean n-space, subspaces, linear independence, basis and dimension. (9 + 3)

SYSTEM OF LINEAR EQUATIONS, EIGENVALUES AND EIGENVECTORS : Errors - approximations and round-off errors – truncation errors, system of linear equations- Naive Gauss elimination method, Crout's method, Gauss– Seidel method, eigenvalues and eigenvectors using power method. (9 + 3)

INTERPOLATION, DIFFERENTIATION AND INTEGRATION : Newton's divided - difference interpolating polynomials, Lagrange interpolating polynomials, equally spaced data - Newton's forward and backward interpolating polynomials, numerical differentiation - evenly spaced data, numerical integration - Newton-cotes formulae, trapezoidal rule, Simpson's 1/3 rule. (9 + 3)

NUMERICAL SOLUTION TO ORDINARY DIFFERENTIAL EQUATIONS : Numerical methods for initial value problem, Taylor-series, Euler's method, modified Euler's method, Runge-Kutta method of 4th order, multi step methods -Milne method. (9 + 3)

NUMERICAL SOLUTION TO PARTIAL DIFFERENTIAL EQUATIONS: Finite difference: elliptic equations - the Laplace equation, Poisson equation - Liebmann method, parabolic equations - heat conduction equation - Crank Nicolson's method, hyperbolic equations – vibrating string. (9 + 3)

Total L: 45 +T: 15 = 60

TEXT BOOKS:

1. Howard Anton and Chris Rorres , "Elementary Linear Algebra", Wiley India, New Delhi, 2018.
2. Steven C Chapra and Raymond P Canale , "Numerical Methods for Engineers", Tata McGraw Hill, New Delhi, 2017.

REFERENCES:

1. David C Lay , "Linear Algebra and its Applications", Pearson, New Delhi, 2016.
2. Curtis F Gerald and Patrick O Wheatly , "Applied Numerical Analysis", Pearson, New Delhi, 2017.
3. Richard L Burden and Douglas J Faires , "Numerical Analysis", Thomas Learning, NewYork, 2017.
4. Ward Cheney and David Kincaid , "Numerical Mathematics and Computing", Cengage Learning, USA, 2018.

19D302 DIGITAL ELECTRONICS AND LOGIC DESIGN

3 0 0 3

DIGITAL ELECTRONICS AND NUMBER SYSTEM : Introduction to digital Circuits - Representation of numbers in binary ,Octal, Decimal and Hexadecimal systems - Conversion between systems - 1's and 2's complement representation of numbers - Signed and Unsigned numbers - Fixed point and Floating point numbers - Computer codes. (9)

COMBINATIONAL CIRCUIT DESIGN : Logic gates: Operation , Truth table , Universal logic gates - Boolean algebra: Basic postulates and fundamental theorems - Boolean functions: Canonical and Standard forms - Gate level minimization: K maps and Quine McClusky methods - Applications: Binary adder, Subtractor, Magnitude comparator, Decoders, Encoders, Multiplexers,

Demultiplexers and Code converters. (10)
SEQUENTIAL CIRCUIT DESIGN : Latches: SR and D latches - Flip flops : Level and Edge triggering , D , JK and T flip flops - Master slave configuration - Mealy/Moore models of finite state machines - Concept of state - State diagram - State table – Sequence detector - Serial adder-Shift register – Counters: Up/down, Modulus, Ring, Johnson counter, Timing diagram. (10)

DIGITAL INTEGRATED CIRCUITS : Characteristics of digital ICs - CMOS circuits: CMOS inverter , NAND and NOR gates, Open drain gates , Tristate gates - TTL circuits: TTL inverter , NAND gate , Open collector gates , Tristate gates - Current sinking and Current sourcing - Comparison of CMOS and TTL performance. (8)

MEMORY AND PROGRAMMABLE LOGIC : Random access memory - Memory decoding - Read only memory –Programmable Logic Array - Programmable Array Logic - Sequential programmable devices: SPLD , CPLD, FPGA. (8)

Total L: 45

TEXT BOOKS:

1. Morris Mano M, Michael D Ciletti, John F Wakerly, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog", Pearson Education, Chennai, 2018.
2. Thomas L.Floyd , "Digital Fundamentals", Pearson Education, England, 2017.

REFERENCES:

1. Salivahanan S, Arivazhagan S , "Digital Circuits and Design", Oxford University Press, New Delhi, 2018.
2. Donald Givone , "Digital Principles and Design", McGraw Hill Education, New Delhi, 2017.
3. David J Comer , "Digital Logic and State Machine Design", Oxford University Press, New Delhi, 2016.
4. Anand Kumar A , "Fundamentals of Digital Circuits", PHI Learning, New Delhi, 2016.

19D303 HUMAN ANATOMY AND PHYSIOLOGY

3 0 0 3

ANATOMY AND SPECIAL SENSES : Circulatory system - Digestive system - Respiratory system - Nervous system – Musculoskeletal system - Optics of vision: Receptor, Neural function of the retina, Photochemistry of vision, Central neurophysiology of vision - Physiology of hearing mechanism , Hearing loss, Hearing tests - Taste sensors - Smell sensors. (15)

THE CELL AND GENERAL PHYSIOLOGY : Structure of the cell - Function of each components of the cell - Genetic control of protein synthesis - Cell reproduction - Membrane potential - Action potential: Generation , Conduction - Electrical simulation - Blood cells - Immunity - Blood clotting - Blood groups - Estimation of : RBC, WBC, Platelets. (8)

CARDIAC AND NERVOUS SYSTEM : Cardiac cycle - Blood pressure - Feedback control of blood pressure - Nervous control of heart - Coronary and Peripheral reflex action - Velocity of conduction of nerve impulses - Central nervous system. (7)

RESPIRATORY SYSTEM : Pulmonary ventilation - Physical principles of gas exchanges - Transport:: Oxygen and Carbon dioxide in the blood and body fluids - Regulations of respiration - Distribution of respiratory function. (7)

DIGESTIVE AND EXCRETORY SYSTEMS : General principles of gastrointestinal function - Secretory functions of the alimentary tract - Digestion and Absorption in the gastrointestinal tract - Structure of Nephron - Mechanism of urine formation - Skin and Sweat gland - Temperature regulation. (8)

Total L: 45

TEXT BOOKS:

1. Jain A K , "TextBook of Physiology", Avichal Publishing Company, New Delhi, 2017.
2. Arthur C Guyton, John E Hall , "Textbook of Medical Physiology", Saunders Elsevier, Pennsylvania, 2015.

REFERENCES:

1. Anil Baran Singha Mahapatra , "Essential of Medical Physiology", Current Book International, Kolkata, 2014.
2. Ranganathan T S , "TextBook of Human Anatomy", S.Chand & Co. Ltd, New Delhi, 2012.
3. Sujit K Chaudhuri , "Concise Medical Physiology", New Central Book Agency Pvt. Ltd, Kolkata, 2011.
4. Sarada Subramanyam, K Madhavan Kutty, Singh H D, "Textbook of Human Physiology", S Chand and Company Ltd, New Delhi, 2012.

19D304 SIGNALS AND SYSTEMS

3 1 0 4

INTRODUCTION : Signals: Transformation of signals, Basic signals - System , Properties of system - Linear time invariant system , Continuous time LTI system , Convolution integral - Discrete time LTI system, convolution sum - Properties of LTI system - Systems described by differential and difference equation. (9 + 3)

FOURIER ANALYSIS OF SIGNALS AND SYSTEMS : CTS: Response of LTI system to complex exponentials – Fourier series and convergence – CTFT , Properties , Frequency response of system – DTS: Response of LTI system to Complex exponentials –

DTFS – DTFT , Properties, Frequency response of system. (9 + 3)

FILTERING : Introduction - Ideal frequency selective filters - Non ideal frequency selective filters - Continuous time frequency selective filters - Discrete time frequency selective filters - Recursive and non recursive - Class of Butterworth frequency filters. (9 + 3)

SAMPLING : Introduction - Sampling theorem: Aliasing, Reconstruction of signal , Interpolation - Discrete time processing of CT signals, Sampling in frequency domain, Sampling of discrete time signals, Discrete time decimation and interpolation. (9 + 3)

TRANSFORMS FOR SYSTEMS : Laplace transform: ROC, Inverse Laplace transform , Pole-Zero Plot, Properties , Analysis and Characterization of LTI system - Z- transform: ROC, Inverse Z-transform , Pole-Zero Plot, Properties , Analysis and Characterization of LTI system. (9 + 3)

Total L: 45 +T: 15 = 60

TEXT BOOKS:

1. Oppenheim A V, Wilsky A S and Hamid Nawab S, "Signals and Systems", Prentice Hall of India, New Delhi, 2015.
2. John Semmlow , "Circuits, Signals and Systems for Bioengineers: A MATLAB-Based Introduction", Elsevier, Academic Press, UK, 2018.

REFERENCES:

1. Haykin S, Barry Van Veen , "Signals and Systems", John Wiley and Sons Inc, New Delhi, 2014.
2. Robert B Northrop , "Signals And Systems : Analysis In Biomedical Engineering", CRC Press, New York, 2016.
3. William H Tranter, Rodger E Ziemer, Ronald Fannin D, "Signals & Systems: Continuous And Discrete", Prentice Hall International, New Delhi, 2009.
4. Roberts M J, "Signals and Systems - Analysis using Transform Methods and MATLAB", Tata McGraw Hill, New Delhi, 2011.

19D305 ANALOG CIRCUITS

3 0 0 3

BASICS OF OPERATIONAL AMPLIFIERS : Fundamentals, Characteristics: DC characteristics, Frequency response characteristics, Offset compensation techniques, Stability – Limitations - Single power supply op-amp, Slew rate operational amplifiers, LM324, AC Inverting and Non-Inverting amplifiers. (9)

LINEAR APPLICATIONS OF OPERATIONAL AMPLIFIERS : Inverting and Non-inverting amplifier, Voltage follower, Summing amplifier, Differential amplifier, Instrumentation amplifier, Integrator and Differentiator – V to I and I to V converters, Sinusoidal oscillators, Active filters - types. (9)

NON-LINEAR APPLICATIONS OF OPERATIONAL AMPLIFIERS : Comparator, Schmitt trigger, zero crossing detectors, Sample and hold circuit, Precision diode, rectifiers, peak detector, Clipper and Clamper, Logarithmic and Exponential amplifiers, Multiplier and Divider, waveform generators. (9)

TIMER AND VOLTAGE REGULATORS : 555 Timer: Monostable and Astable multivibrator – Applications, Voltage controlled oscillator, PLL: fundamentals - Characteristics - Lock-in range and Capture range – Applications, IC Voltage regulators. (10)

ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS : Digital to analog converters: Binary weighed resistor type - R-2R Ladder type, Analog to digital converters: Counter type-Successive approximation - Single slope - Dual slope - Flash type ADC - Tracking ADC - DAC/ADC Performance characteristics and comparison. (8)

Total L: 45

TEXT BOOKS:

1. Roy Choudhry D, Shail Jain , "Linear Integrated Circuits", New Age International Pvt. Ltd, New Delhi, 2018.
2. Ramakant A. Gayakwad , "OP-AMP and Linear ICs", Prentice Hall of India, New Delhi, 2015.

REFERENCES:

1. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", Mc Graw Hill India, New Delhi, 2017.
2. Salivahanan, Bhaaskaran, "Linear Integrated Circuits", McGraw Hill India, New Delhi, 2017.
3. Raju Hazare, Raghunandan G, "Linear Integrated Circuits Concepts and Applications", Cengage Learning India Private a. Limited, New Delhi, 2019.
4. Somanathan Nair B, "Linear Integrated Circuits: Analysis Design and Applications", Wiley India Pvt. Ltd, New Delhi, 2009.

19O306 ECONOMICS FOR ENGINEERS

3 0 0 3

INTRODUCTION : Definition – Nature and Scope – Central Problems of an Economy – Positive and Normative Economics– Micro Economics and Macro Economics, Significance of Economics, Economic Assumptions. (9)

THEORY OF CONSUMER BEHAVIOR : Utility – Indifference Curve Analysis - Properties, Consumer's Budget Line - Demand Analysis: Demand Function and Law of Demand, Elasticity of Demand. Demand forecasting using Econometric Techniques. Supply – Factors Affecting Supply, Market Equilibrium Price, Consumer Surplus. (9)

PRODUCTION, COST AND REVENUE : Production Function, Total Product, Average Product and Marginal Product, Returns to Scale. Costs, Nature of Costs, Short-run and Long-run Cost Curves, Revenue concepts. (9)

MARKET STRUCTURE : Types of Markets - Perfect Competition – Characteristics – Imperfect Competition: Monopoly – Monopolistic Competition – Oligopoly and Duopoly - Price Discrimination and Product Differentiation under Different Markets – Price and Output Determination in Short run and Long run and profit maximization. (9)

PERFORMANCE OF AN ECONOMY (MACRO ECONOMICS) : Demand and Supply of Money – Quantity Theory of Money, Banking – Functions of Commercial Banks and Central Bank – Inflation – Causes – Control Measures – National Income – Concepts – Methods of Calculating National Income – Problems in Calculating National Income. (9)

Total L: 45

TEXT BOOKS:

1. Varian H.R. , "Intermediate Microeconomics", East– West Press, New Delhi, 2014.
2. Dewett.K.K, Navalur. M.H. , "Modern Economic Theory", S. Chand, New Delhi, 2015.

REFERENCES:

1. William A, Mc Eachern, Simrit Kaur , "Micro ECON", Cengage Learning, Noida, 2013.
2. William A, Mc Eachern, Indira A. , "Macro ECON", Cengage Learning, Noida, 2014.
3. Deepashree , "Principles of Economics", Ane Books Pvt Ltd, New Delhi, 2010.
4. Dwivedi , "Essentials of Business Economics", Vikas Publishing House Pvt Ltd, New Delhi, 2010.

19D310 PHYSIOLOGY LABORATORY

0 0 4 2

1. Microscope with Neubauer chamber
2. Estimation of RBC count
3. Estimation of WBC count
4. Estimation of eosinophil count
5. Estimation of platelet count
6. Estimation of differential count
7. Hemoglobin estimation
8. Packed cell volume/ ESR
9. Blood grouping/ osmotic fragility
10. Bleeding time/ clotting time

Total P: 60

19D311 ANALOG AND DIGITAL CIRCUITS LABORATORY

0 0 4 2

1. Inverting and Non-inverting amplifier
2. Integrator and Differentiator
3. Instrumentation amplifier
4. Active low pass, High pass filter and Band pass filter
5. Astable and Monostable Multivibrator
6. Code converters
7. Multiplexers and Demultiplexers
8. Shift registers
9. Counters
10. Sequence detector

Total P: 60

19K312 ENVIRONMENTAL SCIENCE

2 0 0 0

INTRODUCTION TO ENVIRONMENT : Environment - Definition, scope and importance. Types and composition of atmosphere – particles, ions and radicals. Ozone layer- significance, formation and depletion. Ecosystems- Structure and functions, components, energy flow, food chains, food web, Biodiversity-levels, values and threats – India as a mega-diversity nation – hotspots of biodiversity – endangered and endemic species of India –conservation of biodiversity. (6)

ENERGY RESOURCES : Introduction – National and International status- exploitation - sustainable strategies- Fossil fuels- classification, composition, physico-chemical characteristics and energy content of coal, petroleum and natural gas; solar energy -

introduction, harnessing strategies. Wind energy - availability, wind power plants, wind energy conversion systems, site characteristics, and types of wind turbines. Supporting renewable energy resources - tidal –geothermal -hydroelectric. (6)

ENVIRONMENTAL POLLUTION : Definition – Sources, causes, impacts and control measures of (a) Air pollution (b)Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards (h) RF hazards - Role of an individual in prevention of pollution. Disaster management: Floods, earthquake, cyclone and landslides – Case studies, consequences and rescue measures. (6)

WASTE MANAGEMENT : Wastewater - Characteristics of domestic and industrial wastewater - COD and BOD – Various stages of treatment – primary, secondary, tertiary treatment- Biological and advanced oxidation processes. Solid waste management – Characteristics of municipal solid waste(MSW), biomedical, automobile and e-wastes and their management – landfills, incineration, pyrolysis, gasification and composting. (6)

SOCIAL ISSUES AND THE ENVIRONMENT : Environmentally Sustainable work practices- Rain water harvesting – Role of non-governmental organizations. Human ethics and rights- impact on environment and human health – role of information technology on environment and human kind. Green IT policies, Process of EIA - ISO 14000. Legislation- Environment protection act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act. (6)

Total L: 30

TEXT BOOKS:

1. Gilbert M.Masters , "Introduction to Environmental Engineering and Science", Pearson Education, New Delhi, 2004.
2. De A K , "Environmental Chemistry", New Age International P Ltd, New Delhi, 2006.

REFERENCES:

1. Benny Joseph , "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2006.
2. KoteswaraRao MVR , "Energy Resources: Conventional & Non-Conventional", BSP Publications, New Delhi, 2006.
3. Deswal S and Deswal A , "A Basic Course in Environmental Studies", Dhanpat Rai and Co, New Delhi, 2004.

SEMESTER - 4

19D401 PROBABILITY AND STATISTICAL INFERENCE

3 1 0 4

PROBABILITY AND DISCRETE RANDOM VARIABLES : Probability, axiomatic approach to probability, Baye's theorem, discrete random variables, probability mass function, cumulative distribution function -families of discrete random variables - binomial, Poisson and geometric random variables, cumulative distribution functions, expectations. (9 + 3)

CONTINUOUS RANDOM VARIABLES : Continuous random variables, probability density function, cumulative distribution functions, families of continuous random variables - uniform, exponential, Weibull and Gaussian random variables, expectations. (9 + 3)

PAIRS OF RANDOM VARIABLES : Joint cumulative distribution function – joint probability mass function – marginal probability mass function – joint probability density function – marginal probability density function – expected values– independent random variables – covariance – correlation- linear regression. (9 + 3)

SUMS OF RANDOM VARIABLES : Expected values of sums- Probability distribution of sum of two random variables- moment generating functions- moment generating function of the sum of independent random variables. (9 + 3)

STATISTICAL INFERENCE : Sampling distribution - Central limit theorem -Point estimation and interval estimation for means, proportions and variances – hypothesis concerning mean, proportion and variance – single and two samples – goodness of fit – test for independence, analysis of variance - completely randomized design, randomized block design. (9 + 3)

Total L: 45 +T: 15 = 60

TEXT BOOKS:

1. Roy D Yates and David J Goodman , "Probability and Stochastic Processes - A friendly Introduction for Electrical and Computer Engineers", Wiley India, New Delhi, 2014.
2. Douglas C Montgomery and George C Runger , "Applied Statistics and Probability for Engineers", Wiley India, New Delhi, 2018.

REFERENCES:

1. Richard A. Johnson , "Miller & Freund's Probability and Statistics for Engineers", Prentice Hall, New Delhi, 2017.
2. Ronald E. Walpole, Raymond H Myers, Sharon L Myers and Keying Ye , "Probability and Statistics for Engineers and Scientists", Pearson, New Delhi, 2016.
3. Robert V. Hogg, Elliot Tanis, Dale Zimmerman , "Probability and Statistical Inference", Pearson Education, USA, 2014.
4. Jay L. Devore , "Probability and Statistics for Engineering and the Sciences", Brooks/Cole, USA, 2015.

19D402 COMPUTATIONAL TECHNIQUES

3 0 0 3

INTRODUCTION : Modeling Biosystems - Constructing engineering models - Solving biomedical engineering models: Polymeric chain reactions, Transcranial magnetic stimulation, Cardiac electrophysiology, Response of the cardiovascular system to gravity - Introduction to Computing - Programming language tools and techniques - Analyzing algorithms and programs. (9)

STEADY STATE BEHAVIOUR : Linear models of biological systems - Force balance in Biomechanics - Biomedical imaging and image processing - Metabolic engineering and cellular biotechnology - Simultaneous linear algebraic equations - Non-linear equations in biological Systems - Molecular bioengineering - Cellular and tissue engineering - Bioheat transport - Computational methods for solving simultaneous Nonlinear Equations. (9)

DYNAMIC BEHAVIOUR : Dynamic Systems - Pharmacokinetics - Metabolic Engineering - Diffusion across biological membranes: Diffusion of macromolecules and controlled release of drugs, Cell migration on vascular prosthetic materials - Fluid flow in physiological and extracorporeal vessels - Computational methods for solving dynamic systems. (9)

MODELING TOOLS AND APPLICATIONS : Measurements - Errors and Uncertainty - Descriptive Statistics - Inferential Statistics - Fourier Transforms - Applications: Computing statistics of MRI and CT image intensities, Hypothesis testing in DNA microarray analysis, Analysis of mass spectra data, Separating EEG frequency components. (9)

MODELING BIOMEDICAL SYSTEMS : Modeling of bioengineering systems - Simulation - Case studies: ECG simulation, EEG simulation, Model of glucose regulation, Diabetes and insulin regulation, Renal clearance, Motion of rigid body. (9)

Total L: 45

TEXT BOOKS:

1. Richard Khoury, Douglas Wilhelm Harder , "Numerical Methods and Modeling for Engineering", Springer International Publishing, Switzerland, 2016.
2. Steven C Chapra, Raymond P Canale , "Numerical Methods for Engineers with Software and Programming Applications", Tata McGraw,Hill, New Delhi, 2013..

REFERENCES:

1. Stanley M Dun, Alkis Constantinides, V Moghe , "Numerical Methods in Biomedical Engineering", Elsevier Academic Press, Oxford, 2006.
2. Michael R King, Nipa A Mody, "Numerical and Statistical Methods for Bioengineering", Cambridge University Press, USA, 2012.
3. G. Geoffrey Vining, Scott Kowalski , "Statistical Methods for Engineers", Cengage Learning, USA, 2011.
4. Curtis F Gerald, Patrick O Wheatly , "Applied Numerical Analysis", Pearson Education, New Delhi, 2013.

19D403 SENSORS AND MEASUREMENTS

3 0 0 3

SYSTEM OF MEASUREMENT : Measurement System - Classification and Characteristics of Transducers - Errors in Measurements and their statistical analysis - Calibration - Primary and Secondary standards. (6)

DISPLACEMENT, PRESSURE AND TEMPERATURE SENSORS : Strain Gauge: Gauge factor , Sensing elements, Configuration and unbounded strain gage - Capacitive transducer - Inductive transducer - LVD T - Pressure transducer - Passive types: RTD materials & range , Relative resistance vs. temperature characteristics, Thermistor characteristics - Active type: Thermocouple characteristics - Sensors for Environmental monitoring. (10)

PHOTOELECTRIC AND PIEZO ELECTRIC SENSORS : Phototube - Scintillation counter - Photo multiplier tube - Photovoltaic - Photo conductive cells - Phototransistor - Comparison of photoelectric transducers - Optical displacement sensors - Piezoelectric active transducer: Equivalent circuit and its characteristics. - Case study: Optical sensors for diagnosis and therapeutic monitoring. (9)

SIGNAL CONDITIONING CIRCUITS : Functions of signal conditioning circuits - Preamplifiers - Concepts of passive filters - Impedance matching circuits - AC and DC Bridges: Wheat stone ,Kelvin , Maxwell , Hay, Schering. (10)

DISPLAY AND RECORDING DEVICES : Digital voltmeter - Multi meter - CRO: Block diagram , CRT , Vertical & horizontal deflection system - DSO - LCD monitor - PMMC writing systems - Servo recorders – Photographic recorder - Magnetic tape recorder - Inkjet recorder - Thermal recorder. (10)

Total L: 45

TEXT BOOKS:

1. A.K.Sawhney , "Electrical & Electronics Measurement and Instrumentation", Dhanpat Rai & Co, New Delhi, 2015.
2. John G. Webster , "Medical Instrumentation Application and Design", Wiley India Pvt Ltd, New Delhi, 2015.

REFERENCES:

1. Leslie Cromwell , "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2015.
2. Albert D.Helfrick, William D. Cooper , "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, New Delhi, 2016.
3. Khandpur R.S , "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2014.
4. Banshi Dhar Gupta, Anand Mohan Shrivastav and Sruthi Prasood Usha , "Optical Sensors for Biomedical Diagnostics and Environmental Monitoring", CRC Press, New York, 2018.

19D404 ELECTRONIC COMMUNICATION SYSTEMS**3 0 0 3**

ANALOG COMMUNICATION SYSTEM : Introduction: Modulation and its Types - Amplitude Modulation - Power and Current relation - Push Pull balanced modulator - Evolution and Description of SSB Techniques - Frequency Modulation - Carson's rule - Generation of FM : Direct FM and Indirect FM - Foster seeley FM discriminator - Superhetrodyne radio receiver - Telemetry: Principles and applications. (10)

DIGITAL COMMUNICATION SYSTEM : Advantages of digital transmission - Analog to Digital conversion - Pulse code modulation - Pulse Amplitude Modulation - Pulse width Modulation - Delta Modulation - Line coding – Digital Modulation: ASK, FSK, BPSK,QPSK,QAM, Comparison of Bandwidth. (10)

SOURCE AND ERROR CONTROL CODING : Entropy - Source encoding theorem - Shannon fano coding - Huffman coding - Channel capacity - Error Control Coding: Parity codes , Linear block codes ,Cyclic codes. (10)

DATA COMMUNICATION SYSTEM : Introduction - Components - Data flow - Networks - Performance criteria - Physical structures - Topology - Network models: LAN , WAN , MAN - Protocols and standards: OSI model , TCP/IP Protocol suite. (7)

WIRELESS COMMUNICATION SYSTEMS : Evolution of WirelessSystems - Global system for Mobile communication: Cellular architecture , Frequency reuse , Multiple access schemes - Satellite Communication - Bluetooth - Zigbee - WiFi - Body area networks - Ultra wide band communication. (8)

Total L: 45**TEXT BOOKS:**

1. Kennedy G , "Electronic Communication Systems", McGraw Hill, New Delhi, 2017.
2. Wayne Tomasi , ""Electronic Communication Systems: Fundamentals through Advanced", Pearson Education, New Delhi, 2014.

REFERENCES:

1. William Stallings , "Data and Computer Communications", Pearson Education, New Delhi, 2014.
2. T.L.Singal , "Digital Communications", McGraw Hill, New Delhi, 2014.
3. R.S. Khandpur , "Handbook of Biomedical Instrumentation", McGraw Hill Education, New Delhi, 2014.
4. Theodore S Rappaport , "Wireless Communications: Principles And Practice", Pearson Education, New Delhi, 2014.

19D405 BIOMEDICAL INSTRUMENTATION**3 0 0 3**

MEDICAL INSTRUMENTATION SYSTEM : Generalized system - Medical and physiological parameters - Classification of biomedical Instruments - Origin and recording system of bio potentials : Action potential and resting potential, ECG/EKG, EEG , EMG , ENG , ERG , EOG , MEG - Bio potential electrodes - Bioelectric amplifiers : Differential amplifier, Instrumentation amplifier , Isolation amplifier : Transformer coupled , Optically coupled. (12)

CARDIAC SYSTEM MEASUREMENTS : Blood pressure measurement: Indirect methods: Auscultatory, Oscillometric, Direct method : Electronic manometer - Blood flow measurement: Plethysmography - Cardiac output measurements: Indicator dilution , Thermo dilution , Dye dilution - Heart sounds measurement: Origin of heart sound , Phonocardiography - Pulse rate measurement - Pulse oximeters : Transmission oximetry ,Reflection oximetry - Measurement of temperature. (9)

RESPIRATORY AND MUSCULAR SYSTEM MEASUREMENTS : Parameters of respiration - Respiratory flow rate and volume measurement: Impedance pneumograph , Pneumotachometer, Respiratory plethysmography , Spirometer - Cardiopulmonary Exercise and Testing (CPET) - Respiratory gas analyzers - Analysis of muscle and nerve cell waveforms - Muscle and nerve stimulation and conduction measurements - Fatigue characteristics of muscle. (9)

CLINICAL LABORATORY EQUIPMENTS : Measurement of blood gas: pH , pO₂ , pCO₂ , Blood gas analyzer Electrophoresis - Colorimeter - Spectrophotometer - Flame photometer - Auto analyzer - Blood cell counter -Chromatography - ELISA test. (6)

PHYSIOTHERAPY AND ELECTROTHERAPY EQUIPMENTS : Diathermy : Short wave , Microwave , Ultrasonic therapy unit - Electrotherapy: Strength - Duration curve, Types of stimulator currents , Electro diagnostic/therapeutic stimulator, Types of stimulators: Nerve-muscle stimulator, Ultrasonic stimulator, Bladder stimulator - Surgical diathermy machine: Electrodes, Safety aspects ,Surgical diathermy analyzers. (9)

Total L: 45

TEXT BOOKS:

1. John G. Webster , "Medical Instrumentation Application and Design", Wiley India Pvt Ltd, New Delhi, 2016.
2. Joseph J.Carr, John M. Brown , "Introduction to Biomedical Equipment Technology", Pearson Education, 2013.

REFERENCES:

1. Khandpur R.S , "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2014.
2. Leslie Cromwell , "Biomedical Instrumentation and Measurement", Prentice Hall of India Pvt Ltd, New Delhi, 2017.
3. John D .E, Susan M.B, Joseph Bronzino , "Introduction to Biomedical Engineering", Elsevier Ltd, Boston, 2012.
4. Joseph D Bronzino , "Biomedical Engineering Handbook", CRC Press, Newyork, 2000.

19D406 BIOMEDICAL SIGNAL PROCESSING

2 2 0 4

INTRODUCTION TO FAST FOURIER TRANSFORM : Review of sampling - Finite word length effects: Fixed and Floating point representation, Quantization noise , Quantization error , Limit cycle oscillations - FFT algorithms & its application to convolution, Overlap -add & Overlap-save methods. (6 + 6)

DIGITAL FILTERS : Characteristics of analog filters: Butterworth - Chebyshev - IIR filter design: Analog to digital transformation, Bilinear transformation. Digital filters, IIR and FIR structures realization -FIR filter design using windows. (6 + 6)

BIOMEDICAL SIGNALS AND ARTIFACT REMOVAL: Nature of biomedical signals: Characteristics , Interference associated with each bio-signal - Computer aided diagnosis. Time domain filtering: Synchronous averaging, Moving average filters, Derivative based - Frequency domain filtering : FIR, IIR , Notch, Comb - Optimal filtering, Adaptive filtering using LMS algorithm, Applications. (6 + 6)

EVENT DETECTION AND WAVESHAPe ANALYSIS : Detection of events and waves: QRS detection in ECG using Pan Tompkins algorithm, Rhythms detection in EEG using correlation analysis, Extraction of vocal tract response in speech using homomorphic filtering - Analysis of Waveshape and waveform complexity: Trends and energy level in PCG signal, Analysis of activity in EMG - Measures related to waveform complexity. (6 + 6)

FREQUENCY DOMAIN CHARACTERIZATION : Fourier spectrum Introduction , Non parametric methods for power spectral density(PSD) estimation , Periodogram , Modified Periodogram, Bartlett - Welch & Blackman-Tukey methods, Performance comparison - Measures derived from PSD's. (6 + 6)

Total L: 30 +T: 30 = 60

TEXT BOOKS:

1. Rangaraj M Rangayyan , "Biomedical Signal Analysis: A Case-Study Approach", Wiley India, New Delhi, 2015.
2. Alan V. Oppenheim and Ronald W. Schafer , "Digital Signal Processing", Pearson Education, Harlow, 2014.

REFERENCES:

1. Dimitris G. Manolakis, Vinay K Ingle . "Applied Digital Signal Processing: Theory and Practice", Cambridge University Press, New York, 2011
2. Emmanuel C. Ifeachor, Barrie W. Jervis, "Digital Signal Processing: A Practical Approach" Prentice Hall, Harlow, 2011.
3. Eugene N. Bruce, "Biomedical Signal Processing And Signal Modeling", Wiley India, New Delhi, 2009.
4. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", Prentice Hall of India, New Delhi, 2007.

19D410 BIOMEDICAL INSTRUMENTATION LABORATORY

0 0 2 1

1. Recording of ECG and Heart Rate measurement
2. Recording of EEG and EOG
3. Recording of EMG
4. Blood pressure measurement
5. Heart sounds measurement using PCG
6. Measurement of respiration rate and lung volume
7. Measurement of vital parameters using Patient Monitoring System
8. Real time biosignal acquisition using labVIEW
9. Testing of cutting and coagulation using surgical diathermy
10. Study of electrical isolation using electrical safety analyzer

Total P: 30

19D411 PYTHON PROGRAMMING LABORATORY

0 0 4 2

PROBLEM SOLVING RELATED TO THE FOLLOWING TOPICS:

1. Programs related to integers, float, complex, Boolean data types in the shell
2. Input/output and conditional statements in scripts
3. Different operator and conversion functions
4. Loops : for and while
5. String datatype: Creation, Operations, Methods
6. Tuple data type: Creation, Operations, Methods
7. Set and frozenset datatypes: Creation, Operations, Methods
8. Dictionary datatype:Creation, Operations, Methods
9. Functions: definitions , parameter passing, returning datatypes
10. Lambda and recursive functions
11. Creating modules and packages
12. Handling exceptions
13. File handling

Total P: 60

REFERENCES:

1. Mark Summerfield , "Programming in Python 3: A Complete introduction to the Python Language", Addison- Wesley Professional, 2009.
2. Reema Thareja , "Python Programming : Using Problem Solving Approach", Oxford university Press, 2017.
3. Paul Barry , "Head First Python: A Brain-Friendly Guide", O'Reilly Media, 2016.

19Q413 SOFT SKILLS DEVELOPMENT

0 0 2 1

SOFT SKILLS DEVELOPMENT :

1. Body Language and Professionalism
2. Interpersonal skills
3. Goal setting
4. Impression Management
5. Team Building
6. Time Management
7. Stress Management
8. Convincing Skills
9. Motivation
10. Change Management
11. Communication Confidence
12. Group discussion basics
13. Personal Interview basics
14. Resume writing

Total P: 30

REFERENCES:

1. Jeff Butterfield , "Soft Skills for Everyone", 6th Edition, Cengage Learning, Delhi, 2015.
2. Rao M S , "Soft Skills - Enhancing Employability", LK International Publishing House, New Delhi, 2011.

19O412 INDIAN CONSTITUTION

2 0 0 0

INTRODUCTION : Evolution of Indian Constitution; Significance of Constitution; Composition; Preamble and its Philosophy. (4)

RIGHTS, DUTIES AND DIRECTIVE PRINCIPLES: Fundamental Rights- Writs and Duties, Directive Principles of State Policy. (6)

COMPOSITION OF PARLIAMENT AND FEDERALISM : Union Government, President and Vice President, Houses of the Parliament and their functions; Composition of State Legislature; Powers, Functions and Position of Governor, Function of Chief Ministers, Council of Ministers; The Indian Federal System, Administrative Relationship between Union and States. (8)

BILLS AND CONSTITUTION AMENDMENT PROCEDURE : Types of Bills, Stages of passing of Bill into an Act, Veto Power, Constitution Amendment Procedure, Various Amendments made and their significance for India. (6)

JUDICIARY : Supreme Court and High Court; Functions and powers, Judicial Review. (6)

Total L: 30

TEXT BOOKS:

1. Subash C. Kashyap , "Our Constitution", 5th Edition, NBT, India, New Delhi, 2015.

2. Basu D D , "Introduction to the Constitution of India", 20th Edition, Prentice Hall of India, New Delhi, 2011.

REFERENCES:

1. Brijji Kishore Sharma , "Introduction to the Consitution of India", 8th Edition, Prentice Hall of India, New Delhi, 2017.
2. Hoshiar Singh , "Indian Administration", 1st Edition, Pearson Education, New Delhi, 2011.
3. Jain M C , "The Constitution of India", 5th Edition, State Mutual Book & Periodical Service, Limited, New Delhi, 1988.
4. Shukla V N , "Constitution of India", 13th Edition, Eastern Book Company Limited, New Delhi, 2017.

SEMESTER - 5

19D501 IMAGE PROCESSING

3 0 0 3

DIGITAL IMAGE FUNDAMENTALS : Origin - Elements - Sampling and Quantization - Basic relationships between pixels: Neighbors Adjacency, Connectivity, Distance measures between pixels - Geometric Transformations: Translation, Scaling, Rotation and perspective projection of image. (8)

IMAGE ENHANCEMENT : Basic intensity transformations - Histogram processing techniques - Filtering in spatial domain - Discrete Fourier Transform: Computing and visualizing the 2D DFT, Filtering in frequency domain Homomorphic filtering - Color fundamentals: Color models. (9)

IMAGE RESTORATION : Model of image degradation / restoration - Noise models - Restoration in the presence of noise without degradation by spatial filtering - Periodic noise reduction by frequency domain filtering - Linear Position Invariant Degradation - Estimation of degradation function - Inverse filtering - Wiener filtering – Geometric mean filter. (9)

IMAGE COMPRESSION : Image Compression models - Error Free Compression: Variable Length Coding, Bit,Plane Coding ,Lossless Predictive Coding - Lossy Compression: Lossy Predictive Coding – Image Compression Standards. (9)

IMAGE SEGMENTATION, REPRESENTATION & RECOGNITION: Fundamentals: Point, line and edge detection ,Thresholding , Morphological processing - Representation schemes: Boundary descriptors , Regional descriptor Use of principal components for description - Patterns and Pattern classes: Recognition based on matching. (10)

Total L: 45

TEXT BOOKS:

1. Rafel C Gonzalez, Richard E Woods , "Digital Image Processing", Pearson Education, New Delhi, 2018.
2. Anil K Jain , "Fundamentals of Digital Image Processing", Prentice Hall of India Pvt Ltd, New Delhi, 2016.

REFERENCES:

1. Rafael C Gonzalez, Richard E.Woods, Steven L. Eddins , "Digital Image Processing Using MATLAB", Tata McGraw Hill, New Delhi, 2016.
2. Uvais Qidwai, C.H. Chen , "Digital Image Processing: An Algorithmic Approach with MATLAB", CRC Press, Florida, 2017.
3. Chi, WahKok, Wing, Shan Tam , "Digital Image Interpolation in MATLAB", John Wiley & Sons, Singapore, 2019.
4. VipinTyagi , "Understanding Digital Image Processing", CRC Press, Florida, 2018.

19D502 EMBEDDED SYSTEMS

3 0 0 3

INTRODUCTION TO MICROCONTROLLERS : Microprocessors and Microcontrollers - Harvard and Von Neumann Architecture, Overview of 8051 family - Hardware architecture:CPU,Memory organization, Stack, Portstructure,Special Function Registers. (9)

PROGRAMMING THE 8051 : Addressing modes - Instruction set: arithmetic and logical operations, Boolean processing, Branching - Interrupts - Programming in Assembly level language and C - Introduction to IDE: Assembler directives - External programmer - Development and debugging tools. (9)

PERIPHERALS AND STANDARDS : Counters and Timers - ADC and DAC interfacing - Serial Communication Protocols: UART, SPI, I2C, RS 232, RS 422 Standard - Parallel Communication Protocol: GPIB. (9)

INTERFACING TECHNIQUES : Interfacing input devices: Switches, Key pad, Sensors - Interfacing output devices: LED, Seven segment display, LCD, Buzzer - Interfacing high power devices: DC motors, H-bridge interfacing, Stepper motors. (9)

ADVANCED CONTROLLERS: CISC and RISC architecture - Introduction to Mixed Signal Processing - MSP 430 families: Hardware organization, Register description - Low power operation: Clock system, Operating modes, Power management module - ARM Processors: Cortex-M architecture, Introduction to Arduino, Raspberry Pi and FPGA. (9)

Total L: 45

TEXT BOOKS:

1. Jonathan Volvano, "Introduction to Embedded Systems", CreateSpace Independent Publishing Platform, Austin, 2019.
2. Ming-Bo Lin, "Principles and Applications of Microcomputers: 8051 Microcontroller Software, Hardware, and Interfacing", CreateSpace Independent Publishing Platform, Austin, 2016.

REFERENCES:

1. Douglas Hall, S S S P Rao , "Microprocessors and Its Interfacing - SIE", Tata McGraw Hill, New Delhi, 2017.
2. Ying Bai , "Practical Microcontroller Engineering with ARM Technology", John Wiley & Sons, New Jersey, 2016.
3. Steven F Barrett, Daniel J Pack , "Microcontroller Programming and Interfacing Texas Instruments MSP 430", Morgan & Claypool Publishers, California, 2011.
4. Muhamad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay , "8051 Microcontroller and Embedded Systems", Pearson Education Limited, Harlow, 2013.

19D503 BIOMEDICAL EQUIPMENTS**4 0 0 4**

PHYSIOLOGICAL ASSIST DEVICES : Heart lung machine - Cardiac pacemakers: External, Implantable pacemaker Cardiac defibrillator: DC defibrillator, Implantable defibrillator, Defibrillator analyzer - Dialyzers: Basic principle of dialysis, Different types of dialyzer, Membranes - Infusion pump - Ventilators: Types of ventilators – Anesthesia machine. (12)

RADIOLOGICAL EQUIPMENTS : X-rays: Characteristics - X-ray absorption, Tissue contrast, Instrumentation, Interaction of radiation with matter - X-ray Computerized Tomography (X-ray CT) & MRI : Principle, Instrumentation - Nuclear imaging : Anger scintillation camera, Nuclear tomography, SPECT, PET. (12)

RADIATION THERAPY EQUIPMENTS : Radiation therapy: Linear accelerator, Telegamma Machine, SRS, SRT -Recent Techniques in radiation therapy: 3DCRT, IMRT, IGRT, Cyber knife. (12)

ULTRASOUND AND OTHER TECHNIQUES : Propagation of ultrasound waves in fluids, solids, tissue - Doppler Effect - Ultrasound transducers, Instrumentation - Modes of ultrasonic imaging, Applications - Cardiotocography (CTG) - Thermal imaging techniques - Fluoroscopy - Endoscopy, Surgery navigation. (12)

PATIENT SAFETY AND STANDARDS: Electric Shock Hazards, Leakage Currents, Safety Codes for Electromedical Equipment, Electrical Safety Analyzer, Testing of Biomedical equipment - Regulation of Medical Devices: Types of standards for Medical Devices, Regulatory requirements - Hazardous effect of Radiation: Radiation protection techniques, Safety limits - Radiation measuring instruments: Dosimeter, Film badges, Thermo Luminescent dosimeters, Electronic dosimeter. (12)

Total L: 60**TEXT BOOKS:**

1. John G. Webster , "Medical Instrumentation Application and Design", Wiley India Pvt Ltd, New Delhi, 2015.
2. Leslie Cromwell , "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2015.

REFERENCES:

1. Khandpur R.S , "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2014.
2. Joseph J. Carr, John M. Brown , "Introduction to Biomedical Equipment Technology", Pearson Education, New Delhi, 2013.
3. L.A Geddes, L.E. Baker , "Principles of Applied Biomedical Instrumentation", Wiley India Pvt Ltd, New Delhi, 2008.
4. William R Hendee, Russell Ritenour E , "Medical Imaging Physics", John Wiley & Sons, New York, 2002.

19D504 CONTROL SYSTEMS**3 1 0 4**

PHYSICAL SYSTEM MODELING : Elements of control systems - Mathematical model of control systems - Electrical and Mechanical transfer function models: Force to Current, Force to Voltage analogy - Block diagram reduction techniques - Transfer function of DC and AC servomotor - Signal flow graph: Mason's gain formula. (9 + 3)

TIME RESPONSE AND STABILITY ANALYSIS : Standard test signals - Time response of second order system - Time domain specifications and Characteristics - Steady state error - Static error constant - Introduction to P, PI, PID controller and its Simulation - Concept of stability: Necessary conditions, Routh-Hurwitz criterion, Nyquist criterion, Stability margins, Root locus method. (9 + 3)

FREQUENCY DOMAIN ANALYSIS : Relationship between Time and Frequency response - Performance specifications in frequency domain - Polar plots: Magnitude and Phase angle curve - Bode plots and its Simulation Assessment of stability. (9 + 3)

STATE VARIABLE ANALYSIS & DIGITAL CONTROL SYSTEMS : Concepts of state: State variable, State equations, State models of linear continuous time functions, Diagonalization of transfer function, Solutions of the state equations - Advantages of digital control systems - Discrete time system representation – Mathematical modeling of sampling process and Data reconstruction, Concepts of Controllability and Observability. (9 + 3)

PHYSIOLOGICAL CONTROL SYSTEMS : Physiological control system analysis - Difference between Engineering and Physiological control system - Linear model of physiological system: Respiratory mechanics, Chemical regulation of Ventilation, Thermal Regulation - Regulation of Cardiac output. (9 + 3)

Total L: 45 +T: 15 = 60

TEXT BOOKS:

1. Nagrath I J, Gopal M , "Control System Engineering", New age International, New Delhi, 2018.
2. Michael C.K.Khoo , "Physiological Control Systems", Prentice Hall of India, New Delhi, 2018.

REFERENCES:

1. Norman S. Nise , "Control Systems Engineering", Wiley, New Delhi, 2018.
2. Farid Golnaraghi, Benjamin C. Kuo , "Automatic Control Systems", McGraw-Hill Education, India, 2017.
3. Laszlo Keviczky, Ruth Bars, Jenó Hetthessy , "Control Engineering (Advanced Textbooks in Control and Signal Processing)", Springer Publishers, USA, 2018.
4. Ghosh P.K, Satyajit Anand , "Linear Control Systems", Platinum Publishers, Kolkata, 2015.

19D510 IMAGE PROCESSING LABORATORY

0 0 4 2

1. Study of Image processing Toolkit
2. Image enhancement using point operations
3. Image enhancement using spatial filtering
4. Image enhancement using frequency domain filtering
5. Histogram equalization
6. Analysis of images with different color models
7. Image Restoration
8. Image Compression
9. Image Segmentation
10. Design and implementation of an Image Processing System

Total P: 60

19D511 EMBEDDED SYSTEMS LABORATORY

0 0 4 2

1. Interfacing and programming GPIO ports (blinking LEDs, push buttons)
2. Interfacing a 7-segment display
3. Interfacing a Liquid Crystal Display
4. Interfacing a Keypad
5. Interfacing a potentiometer through ADC and display in LED/LCD
6. Serial Communication using UART
7. Study and familiarization of CCS IDE
8. Study of Capture / Compare modes in Timer
9. Motor Control Using PWM
10. Introduction to Energia IDE

Total P: 60

19D512 DEVICE DESIGN LABORATORY

0 0 2 1

TOPICS FOR ORIENTATION PROGRAM:

In this course the students will be provided with an orientation program on the following topics for duration of 2 hours. After this orientation each student is expected to formulate and complete an activity of interest which has to be derived from the orientation program under the guidance of a faculty. The details like background, problem definition, state-of-art technology/ knowledge in that area by a good literature review, objectives, methodology, equipment, results from the experiments and their interpretation with respect to the assumptions or background and a formal conclusion are expected in the report which is to be submitted at the end of the semester.

1. Problem selection from a database of new medical device requirements given by doctors
2. Concept Generation
3. Planning
4. Modular Implementation
5. Integration
6. Testing and Debugging

Total P: 30

19Q513 BUSINESS AND MANAGERIAL COMMUNICATIONS

0 0 2 1

BUSINESS AND MANAGERIAL COMMUNICATIONS:

1. Advanced Group discussion
2. Advanced Resume writing
3. Mock Group discussion
4. Advanced Personal Interview
5. Mock Personal Interview
6. Cracking special Interviews
7. Essential Grammar for Placements
8. Vocabulary for Placements
9. Email writing
10. Paragraph writing
11. Essay writing

Total P: 30

REFERENCES:

1. Priyadarshi Patnaik , "Group Discussion and Interview Skills", Cambridge, New Delhi, 2011.
2. Hari Mohan Prasad, Rajnish Mohan , "How to Prepare for Group Discussion and Interview", 2nd Edition, Tata McGrawhill, New Delhi, 2009.

SEMESTER - 6

19D601 MEDICAL INFORMATICS

2 1 0 3

INTRODUCTION : Definition - Pioneers in Medical Informatics - Indian and International Organizations - Data, Information and Knowledge - Computer and Network Architectures - Evidence based medicine - Patient Safety - Ethics for Health Informatics - Privacy and Security Issues. (6 + 3)

DATA STANDARDS AND INTEROPERABILITY : Health Information Exchange, ICD, SNOMED - CT, LOINC, CPT, HCPCS, HL7, DICOM, PACS - Hospital Information Systems (HIS): Online functions and Offline reports. (6 + 3)

HEALTH DATA ANALYTICS : Introduction to Data Science - Statistical analysis - Visualization of healthcare data - Analytics for screening, diagnosis and prognosis - Patient centered care analytics - Case studies: Imaging Informatics, Public Health Informatics, Bioinformatics. (6 + 3)

ELECTRONIC HEALTH RECORD : Key components, Computerized Physician Order Entry, Clinical Decision Support System, EHR Adoption and Challenges, Logical steps to Implement EHR - User Interface design. (6 + 3)

APPLICATIONS : Telemedicine - eHealth: HTML and XML - Mobile Technology and mHealth - Virtual Reality (VR): Definition, Types, VR in Physiotherapy - Healthcare Payer Analytics. (6 + 3)

Total L: 30 +T: 15 = 45

TEXT BOOKS:

1. William R. Hersh, Robert E. Hoyt , "Health Informatics: Practical Guide", Lulu Press, North Carolina, 2018.
2. Rivas Homero, Wac Katarzyna , "Digital Health Scaling Healthcare to the World", Springer, Switzerland, 2018.

REFERENCES:

1. David J. Lubliner , "Biomedical Informatics: An Introduction to Information Systems and Software in Medicine and Health", CRC Press, Boca Raton, 2016.
2. Ira J Kalet , "Principles of Biomedical Informatics", Elsevier, Amsterdam, 2014.
3. Chandan K. Reddy, Charu C. Aggarwal , "Healthcare Data Analytics", CRC Press, Boca Raton, 2015.
4. Edward H. Shortliffe, James J. Cimino , "Biomedical Informatics: Computer Applications in Health Care and Biomedicine", Springer, New York, 2014.

19D602 ARTIFICIAL ORGANS

3 0 0 3

INTRODUCTION : Substitutive medicine - Biomaterials - Overview of organ replacement - Design consideration -Evaluation process. (5)

CIRCULATORY DEVICES : Engineering design of Circulatory Assist Devices - Mechanical valves Vs Tissue valves - Current types of prostheses - Hemodynamic assessment of Prosthetic Heart Valves - Implications for thrombus deposition - Durability - Current trends in valve design - Artificial heart: Engineering design and concerns -Circulatory assist devices - Artificial blood. (10)

KIDNEY DEVICES : Kidney disease - Renal failure - Changes in the body fluids in renal disease - Artificial kidney: Dialyzers, Membranes for haemodialysis, Haemodialysis machine, Renal transplantation - Peritoneal dialysis equipment: Therapy format, Fluid and solute removal, Peritoneal membrane physiology, Transport properties -Wearable artificial kidney. (10)

REPLACEMENT DEVICES FOR RESPIRATORY AND DIGESTIVE SYSTEM : Artificial lung versus natural lung - Lung replacement devices - Tracheal replacement devices - Laryngeal replacement devices - Artificial esophagus - Liver functions: Hepatic failure, Liver support systems, General replacement of liver functions - Endocrine pancreas and insulin secretion - Diabetes - Insulin therapy - Insulin administration systems. (10)

HARD AND SOFT TISSUE REPLACEMENT : Dental implants - Fracture plates - Joint and Spinal replacement -Artificial skin: Current treatment for skin loss, Design principles for skin replacement - Ear and Eye implants. (10)

Total L: 45

TEXT BOOKS:

1. Sujata V Bhat , "Biomaterials", Narosa Publishing House, NewDelhi, 2017.
2. Joseph D Bronzino , "Molecular Cellular and Tissue Engineering", CRC Press, London, 2018.

REFERENCES:

1. Gerald Miller , "Artificial Organs", Morgan and Claypool Publisher, Narosa Publishing HouseWilliston, 2006.
2. Nadey S Hakim , "Artificial Organs", Springer Science & Business Media, London, 2009.
3. Megh R Goyal , "Biomechanics of Artificial Organs and Prostheses", Apple Academic Press, Florida, 2014.
4. Joseph D. Bronzino, Donald R. Peterson , "Tissue Engineering and Artificial Organs", CRC Press, NewYork, 2006.

19D603 BIOMECHANICS

3 0 0 3

INTRODUCTION : Perspective of biomechanics, Terminologies - Kinematic and kinetic concepts for analyzing human motion - Kinetic concepts for analyzing human motion - Linear kinetics of human movement, Equilibrium, Angular kinetics of human movement. (9)

MECHANICS OF SOLIDS AND FLUIDS : Constitutive Equation for stress-strain relationship - Models of viscoelasticity - Flow properties of fluids - Rheology of blood in microvessels - Relationship between Shear stress and Shear rate. (9)

MECHANICS OF HARD AND SOFT TISSUES : Structure, Composition and Mechanical properties of Bone, Ligaments, Tendons, Skeletal muscles and Skin. (9)

MECHANICS OF JOINTS : Types of joints , Classification - Skeletal joints - Joints of upper extremity: Shoulder, Elbow - Joints of lower extremity: Hip, knee and ankle - Spinal cord. (9)

APPLICATIONS: Gait Analysis - Exoskeleton design - Ergonomics - Sports mechanics: Performance Analysis - Biomechanical analysis - 3D printing. (9)

Total L: 45

TEXT BOOKS:

1. Susan J Hall , "Basic Biomechanics", Tata McGraw Hill, 2014.
2. Peter M McGinnis , "Mechanics of Sports and Exercise", Human kinetics, 2013.

REFERENCES:

1. Prof. Anthony J. Blazevich , "Sports Biomechanics: The Basics: Optimizing Human Performance", Bloomsbury Publishing, London, 2017.
2. Fung Y C , "Biomechanics: Mechanical Properties of Living Tissues", Springer science and Business media, SanDiego, 2013.
3. David Levine, Jim Richards, Michael Whittle , "Whittles Gait Analysis", Elsevier, China, 2012.
4. Anna Kaziunas France , "Make: 3D Printing:The Essential Guide to 3D Printers", Maker Media, Inc, Canada, 2013.

19D604 BIOMEMS AND NANOTECHNOLOGY

3 0 0 3

INTRODUCTION TO MEMS : Microsystems and microelectronics - Microsystem and miniaturization - Scaling laws in miniaturization - MEMS challenges - Materials for MEMS: Substrates and wafers, Silicon and its compounds, Gallium arsenide, Quartz, Piezoelectric crystals and Polymers. (9)

MICRO AND NANOFABRICATION : Bottom-up and Top-down Approach: Photolithography – Soft lithography - Ion implantation - Doping and Diffusion of elements - Material deposition techniques: Chemical and physical vapor deposition - Etching - Micromachining: Bulk and surface micromachining - LIGA Process. (9)

MICROFLUIDICS : Introduction to fluids and fluid properties - Microscale behavior of fluids - Microchannels - Laminar flow in microchannels and circular conduits - Fluid actuation methods - Dielectrophoresis – Microfluid dispenser - Microneedles - Micropumps - Micromixers (9)

SURFACE ENGINEERING - SENSING AND DETECTION METHODS : Interaction between surfaces and biomolecules: Physisorption and chemisorption, Hydrophilic and hydrophobic - Surface engineering: Self-assembled monolayers, Physisorption and Cross-linking - Sensor design characteristics - Sensing mechanism: Resistive, Capacitive, Inductive and Pressure - Detection methods: Electrochemical – Optical, Acoustic and Surface Plasmon Resonance. (9)

APPLICATIONS : CAD for MEMS - Micro Total Analysis system - Lab-on-Chip devices - Microactuators and Drug delivery - DNA microarrays - Implantable microelectodes - Microtools for surgery. (9)

Total L: 45

TEXT BOOKS:

1. Albert Folch , "Introduction to BioMEMS", CRC Press, New York, 2016.
2. Sunipa Roy, Chandan Kumar Sarkar , "MEMS and Nanotechnology for Gas Sensors", CRC Press, Florida, 2017.

REFERENCES:

1. Tai Ran Hsu , "MEMS and Microsystems Design and Manufacture", Tata McGraw - Hill Publishing Company Limited, New Delhi, 2002.
2. Steven Saliterman , "Fundamentals of BioMEMS and Medical Microdevices", SPIE Press, Washington, 2006.
3. Stephen D Senturia , "Microsystem Design", Springer, New York, 2013.
4. Ellis Meng , "Biomedical Microsystems", CRC Press, New York, 2011.

19D610 MEDICAL INFORMATICS LABORATORY

0 0 2 1

1. Study of open source Electronic Health Record software
2. Generation and manipulation of Electronic Health Records
3. Web page creation using HTML
4. Web page creation using XML
5. Preprocessing and visualization of healthcare data
6. User interface design
7. Creation of class and object in Java
8. Inheritance in Java programming
9. Study of Mobile application development software
10. Creation of a mHealth application

Total P: 30

19D611 BIOMECHANICS LABORATORY

0 0 2 1

1. Measurement of Anthropometric parameters
2. Introduction to Computer Aided Modeling software
3. 2D and 3D Modeling
4. Modeling and simulation of biomechanical behavior of femur bone
5. Modeling and simulation of flow in blood vessel
6. Design of prosthetics using 3D printer
7. Measurement of involuntary movements
8. Design of Control mechanism using voluntary movements
9. Spatial and Temporal Analysis of Human Gait using Kinect
10. Measurement of ground reaction forces using Force platform

Total P: 30

19D620 INNOVATION PRACTICES

0 0 4 2

THE MINI-PROJECT INVOLVES THE FOLLOWING:

1. **PREPARING A PROJECT - BRIEF PROPOSAL INCLUDING**
 - Problem identification
 - A statement of system / process specifications proposed to be developed (block diagram / concept tree)

- List of possible solutions including alternatives and constraints
 - Cost benefit analysis
 - Time Line of activities
2. **A REPORT HIGHLIGHTING THE DESIGN FINALIZATION [BASED ON FUNCTIONAL REQUIREMENTS & STANDARDS (IF ANY)]**
 3. **A PRESENTATION INCLUDING THE FOLLOWING:**
 - Implementation phase (Hardware / Software / both)
 - Testing & validation of the developed system
 - Learning in the project
 4. **CONSOLIDATED REPORT PREPARATION**

Total P:60

19Q613 QUANTITATIVE AND REASONING SKILLS

0 0 2 1

QUANTITATIVE AND REASONING SKILLS :

1. Number System, Time and Work
2. Percentages , Simple and Compound Interests
3. Time, Speed and Distance
4. Permutation, Combination and Probability
5. Ratio and Proportion
6. Profit, Loss and Partnership
7. Logarithms, Progressions, Geometry and Quadratic Equations
8. Coding and Decoding
9. Series, Analogy and Odd Man Out
10. Visual Reasoning
11. Data Arrangements
12. Blood Relations
13. Clocks, Calendars and Direction Sense
14. Cubes, Logical Connectives and Syllogisms
15. Venn Diagrams, Interpretations and solving

Total P: 30

REFERENCES:

1. Aggarwal R S , "Quantitative Aptitude for Competitive Examinations", 3rd Edition, S Chand Publishing, New Delhi, 2017.
2. ETHNUS , "Aptimithra", 1st Edition, McGraw-Hill Education Pvt Ltd, 2013.
3. FACE , "Aptipedia Aptitude Encyclopedia", 1st Edition, Wiley Publications, Delhi, 2016.

SEMESTER - 7

19D701 MACHINE LEARNING

3 0 0 3

INTRODUCTION : Introduction to Probability Theory and Probability Distribution - Formulation of Learning Problem, Learning model, Probabilistic model - Types of learning : supervised, unsupervised, reinforcement - challenges in Machine Learning : error and noise. (8)

SUPERVISED LEARNING : Basic Regression - Linear Regression, Nonlinear regression, Basic Classification - Decision Trees, Nearest neighbor, Probabilistic Approach - Logistic Regression - Bayesian Network - Case Studies : Tumor Type Prediction, Vital Signs Monitoring. (10)

NEURAL NETWORKS AND KERNEL METHODS : Introduction to ANN, Perceptron, Multilayer Perceptron, Back propagation, Support Vector Machines - SVM, The Kernel trick, Support Vector Regression, Case Study – Cognitive State Detection. (10)

FEATURE SELECTION : Filter, Wrapper and Embedded Methods, Linear Discriminant Analysis (LDA), mRMR Feature Selection. (8)

UNSUPERVISED LEARNING : Dimensionality Reduction - KL Transform - Singular Value Decomposition (SVD) - Eigenspace and Eigen Analysis - Clustering: k means, Gaussian Mixture Models, Principal Component Analysis (PCA) - Case Study in Medical Imaging. (9)

Total L: 45

TEXT BOOKS:

1. Abu-Mostafa Y.S., Magdon-Ismaali M., Lin H.T , "Learning from Data", AMLBook Publishers, California, 2017.
2. C.M.Bishop , "Pattern Recognition and Machine Learning", Springer Information Science and Statistics, Switzerland, 2007.

REFERENCES:

1. Shalev S., Shai S., David B. , "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, Cambridge, 2015.
2. Solomon J , "Numerical Algorithms: Methods for Computer Vision, Machine Learning, and Graphics", CRC Press, Florida, 2015.
3. Rogers S., Girolami M , "First Course In Machine Learning", CRC Press, Florida, 2015.
4. Laurene V. Fausett , "Fundamentals of Neural Networks: Architectures, Algorithms and Applications", Pearson Education India, New Delhi, 2004.

19D702 BIOFLUIDICS AND THERMODYNAMICS**3 0 0 3**

FLUID STATICS : Basic concepts of fluid mechanics - Static equilibrium - Surface tension - Membrane and cortical tension Constitutive relation: Newton's law of viscosity , Non-Newtonian rheology , Time-dependant viscoelastic behavior - Dimensionless numbers - Laminar and turbulent flow - Slip and No-slip boundary conditions. (9)

FLUID KINEMATICS : Control volume - Velocity field - Flow rate - Acceleration - Streamlines - Stream tubes and Streak lines - Conservation relations and boundary conditions: Conservation of mass, Momentum balances, Forces and boundary conditions - Applications: Flow induced by a sliding plate - Pressure driven flow through a rectangular and cylindrical channel. (10)

THERMODYNAMICS : Introduction - Energy - Entropy - Reversible and Irreversible processes – Thermodynamic laws Balance equation - Principle of mass transfer: Diffusion and convection. (8)

THERMAL TRANSPORT IN BIOLOGICAL SYSTEMS : Heat transfer and temperature variation within the human body - Blood perfusion through capillaries in tissues - Bioheat equation - Metabolic heat generation - Heat conduction within the tissue - Interaction between the human skin surface and surroundings. (9)

FLUIDICS OF BLOOD AND OTHER FLUIDS : Rheology of blood - Oscillating fluid flow - Flow in curved vessels - Flow in Branched vessels - Flow in arteries - Turbulent flow in heart valves - Fluid flow in lungs and kidneys – Nanoscale drug delivery systems. (9)

Total L: 45**TEXT BOOKS:**

1. Yunus A. Cengel, Michael A. Boles , "Thermodynamics: An Engineering Approach", Tata McGraw-Hill Publications, New York, 2015.
2. Ali Ostadfar , "Biofluid Mechanics: Principles and Applications", Academic Press, London, 2016.

REFERENCES:

1. George A. Truskey, Fan Yuan, David F. Katz , "Transport Phenomena in Biological Systems", Prentice Hall, New York, 2009.
2. Mustafa Ozilgen, Esra Sorguven Oner , "Biothermodynamics: Principles and Applications", CRC Press, New York, 2016.
3. Y. C. Fung , "Biodynamics: Circulation", Springer Science & Business Media, New York, 2013.
4. John Enderle, Joseph Bronzino , "Introduction to Biomedical Engineering", Academic Press, Oxford, 2012.

19D710 BIO MODELING AND SIMULATION LABORATORY**0 0 2 1**

1. Introduction to Modeling and Simulation Tools
2. Fluid Flow in Straight Channel
3. Fluid Flow in Curved Channel
4. Fluid Flow in Branched Channel
5. Fluid – Structure Interaction Study in Artificial Organs
6. Design of Micropump
7. Design of Gas Sensor
8. Design of Pressure Sensor
9. Design of Cantilever based Biosensor
10. Design of Photoresist Mask For MEMS Device

Total P: 30**19D711 DATA ANALYTICS LABORATORY****0 0 2 1**

1. Introduction to R Environment and R packages
2. Vectors, creating sequences, common functions
3. Generating summaries of categorical and continuous data
4. Branching and looping instructions
5. Preprocessing of given dataset
6. Visualization of data
7. Univariate and Multivariate regression
8. Classification techniques

9. Clustering techniques
10. Computer Aided Decision Making – Miniproject

Total P: 30

19D720 PROJECT WORK I

0 0 4 2

1. Identification of a real life problem in thrust areas
2. Developing a mathematical model for solving the above problem
3. Finalisation of system requirements and specification
4. Proposing different solutions for the problem based on literature survey
5. Future trends in providing alternate solutions
6. Consolidated report preparation of the above

Total P:60

SEMESTER - 8

19D820 PROJECT WORK II

0 0 8 4

THE PROJECT INVOLVES THE FOLLOWING:

PREPARING A PROJECT - BRIEF PROPOSAL INCLUDING

- Problem identification
- A statement of system / process specifications proposed to be developed (block diagram / concept tree)
- List of possible solutions including alternatives and constraints
- Cost benefit analysis
- Time line of activities

A REPORT HIGHLIGHTING THE DESIGN FINALIZATION [BASED ON FUNCTIONAL REQUIREMENTS & STANDARDS (IF ANY)]

A PRESENTATION INCLUDING THE FOLLOWING:

- Implementation phase (hardware / software / both)
- Testing & validation of the developed system
- Learning in the Project
- Consolidated report preparation

Total P: 120

PROFESSIONAL ELECTIVES

19D001 ELECTROMAGNETIC FIELDS IN BIOLOGY AND MEDICINE

3 0 0 3

VECTOR ANALYSIS : Review of vector space - Coordinate systems and transformations: Cartesian , Cylindrical , Spherical coordinates - Line - Surface and Volume integrals - Del operator - Gradient of a scalar - Divergence of vector - Curl of a vector. (8)

ELECTROSTATIC FIELDS : Coulomb's law - Electric field Intensity: Point charge , Line charge ,Surface charge , Volume charge - Electric flux density - Gauss's law - Maxwell's equation - Application of Gauss's law - Electric potential - Relationship between field intensity and potential. (10)

MAGNETOSTATIC FIELDS : Biot - Savart's law - Ampere's circuital law - Maxwell's equation - Applications of ampere's law - Magnetic field Intensity: Line current , Surface current , Volume current - Magnetic flux density - Forces due to magnetic fields - Magnetic torque and moment - Magnetic dipole - Magnetic energy. (10)

BIOLOGICAL EFFECTS OF EMF : Introduction - Electromagnetic radiation: Non ionizing radiation , Ionization by multiple photons - Different forms of fields and waves - Thermal and non thermal effects: Temperature rise , Specific absorption ratio - Mechanism

for action of EMF on cells: Bioactivity characteristics - Case study: MRI principles. (8)

THERAPEUTIC APPLICATIONS: Static and Time varying fields: Biophysical Considerations , Tissue Repair , Orthopedics, Soft Tissue Applications , EMF Sensitivity - Heating Applications: Radio Frequency Energy , RF Heating Mechanisms, Cancer treatment , RF Ablation: Clinical Applications. (9)

Total L: 45

TEXT BOOKS:

1. Frank S, Barnes, Ben Greenebaum, "Biological and Medical Aspects of Electromagnetic Fields", Taylor & Francis, New York, 2018.
2. Sadiku M H , "Elements of Electromagnetics", Oxford University Press, Chennai, 2018.

REFERENCES:

1. Peter Stavroulakis , "Biological Effects of Electromagnetic Fields", Springer, New York, 2013.
2. Hayt, Buck, Akhtar , "Engineering Electromagnetics", Mcgraw Hill Education, Noida, 2015.
3. Gerd Mrozynski Matthias Stallein , "Electromagnetic Field Theory: A Collection of Problems", Springer, Berlin, 2013.
4. Ashutosh Pramanik , "Electromagnetism - Theory and Applications", Prentice Hall of India, New Delhi, 2014.

19D002 MEDICAL OPTICS

3 0 0 3

OPTICAL PROPERTIES OF TISSUE : Refraction - Scattering - Absorption - Light transport in Tissue - Preliminaries to Radiation Transport Theory - Monte Carlo Simulations - Tissue Properties: Refractive Indices, Scattering, Absorption. - Refraction - Scattering - Absorption - Light transport in Tissue - Preliminaries to Radiation Transport Theory - Monte Carlo Simulations - Tissue Properties: Refractive Indices, Scattering, Absorption. (9)

LIGHT-TISSUE INTERACTIONS : Light Interactions with a Strongly Scattering Tissue: Continuous Wave Light, Polarized Light, Short Light Pulses - Opto- Thermal Interactions - Fluorescence - Laser-Biomatter Interaction Laser Therapy. (9)

INSTRUMENTATION IN PHOTONICS : Measurements: Absorption, Scattering , Emission - Instrumental Components: Excitation Light Sources, Optical Filter, Dispersive Devices, Optical Fibers, Polarizers, Detectors – Detection Methods: Time-resolved, Phase-resolved. (9)

OPTICS IN DIAGNOSTICS : Two Photon Excitation Fluorescence Microscopy - Fluorescence Spectroscopy - Ultra Violet Spectroscopy for diagnosis - Near-Field Imaging - Optical Coherence Tomography Imaging - Thermal Imaging for Biological and Medical Diagnostics. (9)

LASER INTERVENTIONS AND TREATMENT: Principles of Photodynamic therapy – Lasers in: Ophthalmology, Dermatology, Gastroenterology, Image Guided Surgery. (9)

Total L: 45

TEXT BOOKS:

1. Lihong V. Wang, Hsin-i Wu , "Biomedical Optics: Principles and Imaging", John Wiley & Sons, New Jersey, 2012.
2. Valery V Tuchin , ""Handbook of Photonics for Biomedical Science """, CRC Press, Boca Raton, 2010.

REFERENCES:

1. Paras N Prasad , ""Introduction to Biophotonics""", John-Wiley & Sons Inc, New York, 2003.
2. Mool C Gupta, John Ballato , "Handbook of Photonics", CRC Press, New York, 2007.
3. Shun Lien Chuang , "Physics of Photonics Devices", John Wiley and Sons, New Jersey, 2009.
4. Gines Lifante , "Integrated Photonics Fundamentals", John Wiley and Sons, England, 2003.

19D003 ULTRASOUND IN MEDICINE

3 0 0 3

INTRODUCTION : History - Role of Ultrasound in Medical Imaging - Stress And Strain Relationships – Acoustic Wave Equation - Acoustic Properties of Biological Tissues - Doppler Effect. (7)

ULTRASOUND TRANSDUCERS : Piezoelectric Effect - Properties of Important Piezoelectric Materials - Ultrasonic Transducers - Acoustic Properties of Transducer Materials - Transducer Beam Characteristics. (9)

GRAY-SCALE ULTRASONIC IMAGING : A (Amplitude)-Mode - B (Brightness)-Mode Imaging - Beam Forming -Speckle - Image Quality - M-Mode - C-Mode - Ultrasound Computed Tomography. (8)

DOPPLER FLOW MEASUREMENTS : Nondirectional CW Flow Meters - Directional Doppler Flow Meters - Pulsed Doppler Flow Meters - Clinical Applications And Doppler Indices - Color Doppler Flow Imaging - Elasticity Imaging Intravascular imaging. (9)

BIOLOGICAL EFFECTS AND APPLICATIONS : Acoustic Phenomena at High-Intensity Levels - Ultrasound Bioeffects: Mechanical Effects and Index - Ultrasound Therapy - Hyperthermia - High-Intensity Focused Ultrasound Lithotripsy - Diagnostic Ultrasound Imaging. (12)

Total L: 45

TEXT BOOKS:

1. KK Shung , "Diagnostic Ultrasound: Imaging and Doppler Flow Measurements", Francis & Taylor, CRC Press, Boca Raton FL, 2015.
2. Szabo T , "Diagnostic Ultrasound Imaging: Inside Out", Elsevier Academic Press, Amesterdam, 2014.

REFERENCES:

1. Jerry L Prince, Jonathan M Links , "Medical Imaging Signals and System", Pearson Education, India, 2014.
2. Sanches, João Miguel, Laine, Andrew F, Suri, Jasjit S , "Ultrasound Imaging: Advances and Applications", Springer-Verlag, New York, 2012.
3. P. Suetens , "Fundamentals of Medical Imaging", Cambridge University Press, Cambridge, UK,, 2009.
4. R.S.C. Cobbold , "Foundations of Biomedical Ultrasound", Oxford University Press, Oxford, UK, 2007.

19D004 MAGNETIC RESONANCE IMAGING

3 0 0 3

FUNDAMENTALS : Introduction - Production of net magnetization - Concepts of magnetic Resonance, Relaxation: T1 relaxation and saturation, T2 relaxation and spin echoes. (10)

PRINCIPLES OF MAGNETIC RESONANCE IMAGING : Gradient fields, Slice Selection - Encoding: Readout or frequency encoding , Phase encoding , Sequence looping , Frequency selective excitation, Composite pulses - Raw data and image data matrices - Raw data and k space - Reduced k space acquisitions - Parallel acquisition techniques. (12)

PULSE SEQUENCES : Spin echo sequences - Gradient echo sequences - Echo planar imaging sequences Magnetization, Prepared sequences. (10)

ARTIFACTS : Motion Artifacts - Sequence / Protocol, Related Artifacts , External artifacts - Motion artifacts reduction techniques: Acquisition parameter modification - Triggering - Flow Compensation - Radial based motion compensation. (8)

ADVANCED APPLICATIONS : Diffusion - Perfusion - Functional Brain Imaging - Ultra High Field Imaging – Noble Gas Imaging. - MR Angiography. (5)

Total L: 45

TEXT BOOKS:

1. Brain M Dale, Mark A. Brown, Richard C. Semelka , "MRI Basic Principles and Applications", John Wiley & Sons, Oxford, 2015.
2. Vincent Perrin , "MRI Techniques", John Wiley & Sons, USA, 2013.

REFERENCES:

1. Govind B Chavhan , "MRI made easy (for Beginners)", Jaypee Publications, New Delhi, 2013.
2. Catherine Westbrook , "Handbook of MRI Technique", John Wiley & Sons, Oxford, 2013.
3. Scott A. Huettel, Allen W. Song, Gregory McCarthy , "Functional Magnetic Resonance Imaging", Springer, China, 2010.
4. Peter Jezzard, Paul M Matthews, Stephen M Smith , "Functional MRI: An Introduction to Methods", Oxford University Press, USA, 2003.

19D005 EMBEDDED SYSTEM DESIGN

3 0 0 3

INTRODUCTION: Definition - Need for embedded applications and philosophy for its development - Hardware and software components - Building an embedded system - Design and development Process - Life cycle. (9)

REAL TIME OPERATING SYSTEMS :Tasks and task management - Memory management - Deadlocks -Performance analysis and optimization (9)

INTERFACING WITH DEVICES : Model of Interprocess communication - Interprocess interaction - Local device model - Interrupts and polling - Remote device model - Interfacing with local devices - Interfacing with remote devices - Design process - Design examples. (9)

ARM PROCESSOR : Design philosophy - Processor fundamentals - Barrel shifter - Memory organization - Instruction set - Pipelined architecture - Instruction level parallelism - Writing and optimizing assembly code – Embedded C programming - Peripheral programming - Exception and interrupt handling. (9)

CASE STUDIES : Smart card based patient identity management systems - Patient monitoring system – Digital endoscopy camera - Heart beat monitoring system. (9)

Total L: 45

TEXT BOOKS:

1. James K. Peckol , "Embedded Systems: A contemporary Design Tool", Wiley-Blackwell, 2019.
2. Shibu Kizhakke Vallathai , "Introduction to Embedded Systems", McGraw Hill Education (I), 2018.

REFERENCES:

1. Steve Heath , "Embedded Systems Design", Elsevier India P Ltd, New Delhi, 2016.
2. Richard Zurawski , "Embedded Systems Handbook: Embedded Systems Design and Verification", CRC Press, Boca Raton, 2014.
3. Frank Vahid, Tony Givargis , "Embedded System Design: A Unified Hardware/Software Introduction", Wiley India Pvt Ltd, New Delhi, 2018.
4. Andrew N. Sloss, Dominic Symes, Chris Wright , "ARM System Developers Guide: Design and Optimizing system software", Elsevier, New Delhi, 2017.

19D006 ADVANCED MEDICAL EQUIPMENTS**3 0 0 3**

FLEXIBLE AND STRETCHABLE MEDICAL DEVICES: History - Carbon Nanotube Based Flexible and Stretchable Electronics: Introduction - Carbon Nanotube networks: Applications in Flexible Electronics, Applications in Stretchable Electronics - Digital Printing. (9)

SURGICAL AND IMAGE-GUIDED TECHNOLOGIES : Instrumentation for Laparoscopic Surgery: Introduction , Basic Principles , Laparoscopic Instrumentation , Trocars - Surgical Instruments in Ophthalmology: Introduction , Cataract Surgery , Principles of Phacoemulsification , Phacoemulsification Instruments , Phacoemulsification Systems , Vitreoretinal Surgery , Principles of Vitrectomy , Vitrectomy Instruments , Vitrectomy Systems - Image Guided Surgery. (9)

SURGICAL ROBOTICS : Introduction - Human-Machine Interfaces: System Approach - Tissue Biomechanics -Teleoperation - Image-Guided Surgery - Commercial Systems: CyberKnife ,daVinci , Sensei X. (9)

IMAGING AND IMAGE-GUIDED TECHNIQUES: Endoscopy: Principles of Modern Endoscopy, Advances in Flexible Endoscope Design - Medical Ultrasound Devices: Intravascular and Intracardiac Applications, Surgical Applications, Ophthalmic Ultrasound. (9)

NEUROSURGERY: Instrumentation in Neurosurgery - Functional Neurosurgery - Neuroimaging for Neurosurgery - Implementation of Neuronavigation: Surgical Planning, Patient Registration, Navigation - Augmented Reality and Virtual Reality. (9)

Total L: 45**TEXT BOOKS:**

1. Kuniharu Takei , "Flexible and Stretchable Medical Devices", John Wiley & Sons, Germany, 2018..
2. Alexandra J. Golby , "Image-Guided Neurosurgery", Elsevier, London, 2015.

REFERENCES:

1. Martin Culjat, Rahul Singh, Hua Lee , "Medical Devices: Surgical and Image-Guided Technologies", John Wiley & Sons, New Jersey, 2013.
2. Joseph J Carr, John M Brown , "Introduction to Biomedical Equipment Technology", Pearson Education, New Delhi, 2013.
3. John G Webster , "Medical Instrumentation Application and Design", John Wiley & Sons, New Delhi, 2015.
4. Leslie Cromwell , "Biomedical Instrumentation and Measurement", Prentice hall of India, New Delhi, 2015.

19D007 HOSPITAL SYSTEMS MANAGEMENT**3 0 0 3**

HOSPITAL ADMINISTRATION: Role of hospitals: Classifications, Primary health care, Medical staff and hospital organization – Health system performance -Health and national economy - Distinction between hospital and industry - Challenges in hospital administration : Hospital planning, Equipment planning, Functional planning. (9)

ORGANISATIONAL BEHAVIOUR : Concept and definition of organization - Management of human resources in health care environment - Principles and methods of work: Employee recruitment, Selection, Retention, Training, Evaluation, Wage and salary administration ,Communication - Psychology and human relationship in hospital -Roles and responsibilities of district - Medical and health officer. (9)

MANAGEMENT FUNCTIONS: Operations - Finance and cost - Human resource - Materials - Biomedical waste - Current issues in hospital management - Case studies. (6)

SUPPORT SYSTEMS : Clinical services: Clinical lab services, Radiology and imaging services - Information services: Management decisions and related information requirements, - Medical information services - Administrative services: Medical records ,Central sterilization and supply , Pharmacy, Food and laundry services. (9)

QUALITY AND SAFETY ASPECTS : Quality system : Elements, Implementation, Documentation, Quality auditing - International standards : ISO and its features : ISO 9001 , ISO 9004, ISO 14000 - Quality control :Six sigma, NABH and levels ,NABA,JCI,NABL -

Security: Loss, Prevention, Fire safety, Alarm system, Hazard and safety rules in a hospital - Health insurance - Health policy - Hospital laws: Doctor and consumer protection act, Act related to manufacture and sale of drugs. (12)

Total L: 45

TEXT BOOKS:

1. Sharma D. K, Goyal R.C , "Hospital Administration and Human Resource Management", Prentice Hall of India Pvt Ltd, New Delhi, 2013..
2. Ramani K.V , "Hospital Administration -Text and Cases", Pearson Education, New Delhi, 2013.

REFERENCES:

1. Goyal R.C , "Handbook of Hospital Personal Management", Prentice Hall of India Pvt Ltd, New Delhi, 2005.
2. Kunders G.D , "Hospitals – Facilities Planning and Management", Tata Mc-Graw Hill Publishers, New Delhi, 2008.
3. Goel S.L , "Hospital Administration and Management: Theory and Practice", Deep and Deep Publications, Chennai,2007.
4. Malhotra A.K , "Hospital Management - An Evaluation", Global India Publications, New Delhi, 2009.

19D008 ENGINEERING OF NANOMATERIALS

3 0 0 3

NANO SCALE MATERIALS : Introduction - Classification of nanostructures - Nanoscale architecture - Effects of the nanometer length scale - Changes to the system total energy - Changes to the system structures - Effect of nanoscale dimensions on various properties: Structural, Thermal, Chemical, Mechanical, Magnetic, Optical and Electronic properties. (9)

NANOMATERIALS SYNTHESIS METHODS : Fabrication methods - Top-down processes: Milling, Lithography and Machining process - Bottom-up process: Vapour phase deposition methods, Plasma-assisted deposition process, Colloidal and sol-gel methods - Methods for templating the growth of nanomaterials - Ordering of nanosystems - Self-assembly and Self-organization. (9)

NANO CHARACTERIZATION TECHNIQUES: General classification of characterization methods - Analytical and imaging techniques - Microscopy techniques: Electron microscopy, Scanning electron microscopy, Transmission electron microscopy, Atomic force microscopy - Diffraction techniques - Spectroscopy techniques: X-ray spectroscopy. (9)

INORGANIC SEMICONDUCTOR NANOSTRUCTURES : Quantum confinement in semiconductor nanostructures - Quantum wells - Quantum wires - Quantum dots - Super lattices - Fabrication techniques - Epitaxial growth - Electrostatically induced dots and wires - Quantum well width fluctuations - Thermally annealed quantum wells. (9)

NANO DEVICES AND APPLICATIONS : Organic FET: Principle, Description, Requirements, Integrated circuits - Organic LED's: Basic processes, Carrier injection, Excitons, Optimization - Organic photovoltaic cells - Carbon nanotubes: Structure, Synthesis, Electronic properties, Applications - Fuel cells - Nanorobots - Nanoparticles for Medical Imaging and Drug Delivery. (9)

Total L: 45

TEXT BOOKS:

1. Dinesh C Agrawal , "Introduction to Nanoscience and Nanomaterials", World Scientific Publishing Company, Singapore, 2013.
2. Pradeep T , "NANO: The Essentials: Understanding Nanoscience and Nanotechnology", McGraw Hill Education, Bengaluru, 2017.

REFERENCES:

1. Michael Kohler, Wolfgang Fritzsche , "Nanotechnology: An Introduction to Nanostructuring Techniques", Wiley- VCH, Weinheim, 2017.
2. William Goddard, Donald W Brenner , "Handbook of Nano Science Engineering and Technology", CRC Press, Boca Raton, 2014.
3. B Wang , "Drug Delivery: Principles and Applications", Wiley Interscience, New Jersey, 2005.
4. Robert W Kelsall, Ian W Hamley, Mark Geoghegan , "Nanoscale Science and Technology", John Wiley and Sons, West Sussex, 2005.

19D009 DRUG DELIVERY SYSTEMS

3 0 0 3

PHARMACOKINETICS AND DYNAMICS : Introduction: Bioavailability, Drug absorption, Pharmacokinetic and Pharmacodynamic processes, Timing for optimal therapy - Terminology of drug delivery and targeting - Routes of administration, Strategies to increase drug absorption - Prodrugs: Bioconjugation , Rate controlled release, Sustained and Controlled delivery of prodrugs. (9)

POLYMERS AS DRUG CARRIERS : Polymers for controlled release, Osmotic pumps, Pulsatile drug delivery systems - Drug polymer conjugates, Gels and Hydrogels, Nano and Microparticles - Synthetic hydrogels, Nano and Microcapsules - Polymers used in the formulation of nano and microspheres - Smart Polymers, pH and Temperature sensitive hydrogels, Capsosomes and Dendrimers. (9)

TARGETED DRUG DELIVERY : Transdermal - Nasal - Pulmonary - Vaginal - Ophthalmic - Targeting to Central Nervous system - Cell and Gene delivery: Delivery of Vaccines. (8)

NANOPARTICLES FOR CANCER THERAPY : Cancer Markers, Folate receptors, Targeting through angiogenesis - Tumour specific targeting, Combination therapy, Neutron capture therapy - Targeting tumour vasculature for imaging - Delivery of specific anticancer agents: Paclitaxel, Doxorubicin, Fluorouracil. (9)

NANOMEDICINE : Properties of nanocarriers - Drug delivery systems used in nanomedicine - Nanoparticles targeting, Theranostic Nanoshells, Nanoporous microsystems for islet cell replacement - Transdermal drug delivery using low frequency sonophoresis - Nanoporous implants for controlled drug delivery – Enhanced Permeability and Retention effect - Health and environmental impacts of Nanotechnology. (10)

Total L: 45

TEXT BOOKS:

1. Raphael M Ottenbrite, Sung Wan Kim , "Polymeric Drugs and Drug Delivery Systems", CRC Press, London, 2019.
2. Chandra P Sharma , "Drug Delivery Nanosystems for Biomedical Applications", Elsevier, Netherlands, 2018.

REFERENCES:

1. Rakesh K. Tekade , "Basic Fundamentals of Drug Delivery", Academic Press, Oxford, 2018.
2. Anya M Hillery, Kinam Park , "Drug Delivery: Fundamentals and Applications", CRC Press, Florida, 2016.
3. Challa S. S. R. Kumar , "Polymeric Nanomaterials", Wiley, Germany, 2011.
4. Sabyasachi Maiti, Kalyan Kumar Sen , "Bio-Targets and Drug Delivery Approaches", CRC Press, Newyork, 2016.

19D010 BIOANALYTICAL TECHNIQUES AND CHARACTERIZATION

3 0 0 3

CENTRIFUGATION AND ELECTROPHORETIC TECHNIQUES : Biomolecules: Amino acids, Peptides , Proteins and Nucleic acids - Quantitative Biochemical Measurements, Modern approaches in Bioanalysis and Bioassays, Centrifugation - Electrophoresis: Principle, Paper electrophoresis , Gel electrophoresis , Electrophoresis of proteins , Electrophoresis of nucleic acids , Capillary electrophoresis. (12)

CHROMATOGRAPHIC TECHNIQUES : Principle, Chromatographic performance parameters - Types: HPLC, Adsorption, Partition, Ion-exchange, Size exclusion, Affinity and Gas chromatography. (8)

MICROSCOPIC TECHNIQUES : Light microscope - Fluorescence microscope - Electron microscope - Application of microscope in analyzing biological samples - Imaging live cells and tissues - Measuring cellular dynamics. (8)

SPECTROSCOPIC TECHNIQUES I : UV-Vis spectroscopy - Fluorescence spectroscopy - Luminometry – Circular Dichroism spectroscopy - Light scattering - Atomic spectroscopy. (9)

SPECTROSCOPIC TECHNIQUES II : Infrared and Raman spectroscopy - Surface Plasmon spectroscopy - X-ray diffraction spectroscopy - Mass spectroscopy. (8)

Total L: 45

TEXT BOOKS:

1. Andreas Hofmann, Samuel Clokie , "Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology", Cambridge University Press, New York, 2018.
2. Victor A. Gault, Neville H. McClenaghan , "Understanding Bioanalytical Chemistry: Principles and Applications", John Wiley & Sons, Oxford, 2013.

REFERENCES:

1. Friedrich Lottspeich, Joachim W. Engels , "Bioanalytics: Analytical Methods and Concepts in Biochemistry and Molecular Biology", John Wiley & Sons, Germany, 2018.
2. Wilson K, Walker J , "Principles and Techniques of Biochemistry and Molecular Biology", Cambridge University Press, NewYork, 2010.
3. Shourie A , "Bioanalytical Techniques", The Energy and Resources Institute (TERI), New Delhi, 2005.
4. Manz A, Pamme N, Lossifidis D , "Bioanalytical Chemistry", World Scientific Publishing Company, Singapore, 2004.

19D011 CELL BIOLOGY AND TISSUE ENGINEERING

3 0 0 3

PRINCIPLES OF CELL BIOLOGY : General organizations of cell - Structure and transport across cell membrane - Membrane potential - Receptors - Cytoskeleton - Cell motility - Cell surface and cell adhesions - Organization of cell nucleus. (9)

INTRODUCTION TO TISSUE ENGINEERING : History and scope of tissue engineering - Dynamics of cell - Extra Cellular Matrix (ECM) interaction - Matrix molecules and their ligands - Principles of tissue culture and Bioreactor design. (9)

STEM CELLS AND GENE THERAPY : Embryonic stem cells - Liver stem cells - Adult epithelial tissue stem cells - Mesenchymal stem cells - Strategies of gene therapy - Ex vivo versus in vivo gene therapy - Gene transfer vector - Cell specific targeting strategies - Combining gene transfer with stem cell strategies. (9)

ENGINEERING METHODS AND DESIGN : Soft lithography - Self assembled monolayer - Micro contact printing - Micro fluidic patterning - Laminar flow patterning - Cell interaction with Polymer scaffolds and gels - Polymer scaffolds fabrications: Electrospinning, Freeze drying, Solvent casting and Particulate leaching, Microfabrication of cell seeded scaffolds. (9)

ORGAN ENGINEERING : Corneal tissue replacement - Cell source for lung repair - Lung tissue engineering -Bioengineering of human skin substitutes - Engineering pancreatic beta cells - Bioartificial liver – Tissue engineering approach to renal function replacement - Regulations and ethics. (9)

Total L: 45

TEXT BOOKS:

1. Robert P Ianza, Robert Langer, Joseph Vacanti , "Principles of Tissue Engineering", Academic Press, California, 2013.
2. Cecie Starr, Ralph Taggart , "Cell Biology and Genetics", Brooks Cole Publishers, California, 2009.

REFERENCES:

1. John P Fisher, Antonios G Mikos, Joseph D Bronzino , "Tissue Engineering", CRC press, Boca Raton, 2007.
2. Bruce Alberts , "Molecular Biology of the Cell", Garland Science Publications, New York, 2008.
3. Bernhard O Palsson, Sangeeta N.Bhatia , "Tissue Engineering", Dorling Kindersley (India) Private limited, Uttar Pradesh, 2009.
4. Yoshito Ikada , "Tissue Engineering: Fundamentals and Applications", Elsevier, Oxford, 2006.

19D012 MODELING OF PHYSIOLOGICAL SYSTEMS

3 0 0 3

INTRODUCTION TO PHYSIOLOGICAL MODELING : Physiological processes & principles of their control, Control mechanism, Blood flow, Gas exchange, Ultra-filtration, Biochemical reactions, Pneumatic transport, Digestion, Energy utilization and waste disposal, Linear and Non-linear control systems, Principles of open loop & feedback systems, Techniques for system response characterization. (8)

PRINCIPLES OF MODELING : Mathematical approach, Electrical analogues, Introduction to process controls of Cardiac rate, Blood pressure, Respiratory rate, Blood-glucose regulation, Electrical model of neural control mechanism. (9)

MODELING OF HUMAN THERMAL REGULATORY SYSTEM : Parameters involved, Control system model, Biochemistry of digestion, Types of heat loss from body, Models of heat transfer between subsystems of human body, Systems within body-environment. (8)

RESPIRATORY AND ULTRA FILTRATION SYSTEM : Modeling of oxygen uptake by RBC and pulmonary capillaries, Mass balancing by lungs, Gas transport mechanisms of lungs, Oxygen and carbon dioxide transport in blood and tissues, Transport through cells and tubules, Diffusion, Facilitated diffusion and active transports, Methods of waste removal, Counter current model of urine formation in nephron, Modeling Henle's loop. (11)

MODELING BODY DYNAMICS : Mechanical properties of bones, Tissues, Modeling of bones, Stress propagation in bones, Hills model of muscle mechanism, Current trends in computer aided modeling. (9)

Total L: 45

TEXT BOOKS:

1. Michal CK Khoo , "Physiological Control Systems: Analysis Simulation and Estimation", Wiley-IEEE Press, New York,2018.
2. Ewart Carson, Claudio Cobelli , "Modelling Methodology for Physiology and Medicine", Elsevier insights,New York,2014.

REFERENCES:

1. John Enderle, Susan Blanchard, Joseph Bronzino , "Introduction to Biomedical Engineering", Academic Press, New York, 2012.
2. Michael Chappell, Stephen Payne , "Physiology for Engineers: Applying Engineering Methods to Physiological Systems", Springer, New York, 2016.
3. Sherwood L , "Human Physiology: From Cells to Systems", Thomson Learning, Singapore, 2015.
4. Willem van Meurs , "Modeling and Simulation in Biomedical Engineering", McGraw-Hill Education, New Delhi, 2011.

19D013 COMPUTATIONAL BIOLOGY AND BIOINFORMATICS

3 0 0 3

INTRODUCTION : Introduction to Operating Systems - Linux commands - File Transfer Protocols: FTP and Telnet - Introduction to Bioinformatics and Computational Biology - Biological Sequences - Biological Databases - Genome Specific Databases - Data File

Formats - Data Life Cycle - Database Management System Models - Basics of Structured Query Language (SQL) - Introduction to Proteins and Nuclei Acids: Structure, Sequencing and Matching. (9)

BIOLOGICAL SEQUENCE ANALYSIS : - Sequence Analysis - Pairwise Alignment - Dynamic Programming Algorithms for computing Edit Distance - String Similarity - Shotgun DNA Sequencing - End Space Free Alignment Multiple Sequence Alignment - Algorithms for Multiple Sequence Alignment - Generating Motifs and Profiles - Local and Global Alignment - Needleman and Wunsch Algorithm - Smith Waterman Algorithm - BLAST – PSIBLAST and PHIBLAST Algorithms. (9)

STRUCTURE PREDICTION : Introduction to Phylogenetics - Distance Based Trees - UPGMA Trees - Molecular Clock Theory - Ultrametric Trees - Parsimonious Trees - Neighbor Joining Trees - Trees Based on Morphological Traits - Bootstrapping - Prediction Methods: Protein Secondary Structure, Tertiary Structure - Homology Modeling - Abinitio Approaches - Threading - Critical Assessment of Structure Prediction - Structural Genomics. (9)

MACHINE LEARNING TECHNIQUES : Artificial Neural Networks in Protein Secondary Structure Prediction - Hidden Markov Models for Gene Finding - Decision Trees - Support Vector Machines. Introduction to Systems Biology and Synthetic Biology - Microarray Analysis - DNA Computing - Bioinformatics Approaches for Drug Discovery - Applications of Informatics Techniques in Genomics and Proteomics: Assembling the Genome - STS Content Mapping for Clone Contigs - Functional Annotation - Peptide Mass Fingerprinting. (9)

BASICS OF PERL PROGRAMMING FOR BIOINFORMATICS : Data types: Scalars and Collections - Operators - Program Control Flow Constructs - Library Functions: String Specific Functions - User Defined Functions – File Handling. (9)

Total L: 45

TEXT BOOKS:

1. Arthur Lesk , "Introduction to Bioinformatics", Oxford University Press, Oxford, 2013.
2. Gautam B. Singh , "Fundamentals of Bioinformatics and Computational Biology", Springer, New York, 2015.

REFERENCES:

1. Dan Gusfield , "Algorithms on Strings, Trees and Sequences: Computer Science and Computational Biology", Cambridge University Press, New York, 1997.
2. Richard Durbin, Sean Eddy, Anders Krogh, Graeme Mitchison , "Biological Sequence Analysis Probabilistic Models of Proteins and Nucleic Acids", Cambridge University Press, Cambridge, 2013.
3. David W. Mount , "Bioinformatics Sequence and Genome Analysis", Cold Spring Harbor Laboratory Press, New York, 2004.
4. James Tisdall , "Beginning Perl for Bioinformatics: An Introduction to Perl for Biologists", O'Reilly Media, California, 2001.

19D014 WEARABLE TECHNOLOGIES

3 0 0 3

INTRODUCTION : Attributes of wearables, Meta-wearable, Challenges and opportunities, Future of wearables - Social aspects of wearability and interaction: Social interpretation of Aesthetics - Case study: Google glass - Wearable haptics: Need for wearable haptic devices - Categories of wearable haptic and tactile display - Wearable sensorimotor enhancer. (9)

WEARABLE SENSORS : Chemical and Biochemical sensors, System design, Challenges in chemical biochemical sensing, Application areas - Inertia sensors, Parameters from inertia sensors - Applications for wearable motion sensors - Measurement of energy expenditure by body worn heat flow sensors. (9)

FLEXIBLE ELECTRONICS : Introduction, Thin-film transistors: Materials and Technologies, Review of semiconductors in flexible electronics - Low-power Integrated Circuit Design for biopotential sensing: Analog circuit design techniques - Low- power design for ADCs - Digital circuit design techniques - Architectural design for low-power biopotential acquisition, Practical considerations. (9)

ENERGY HARVESTING SYSTEMS : Energy harvesting from human body: Temperature gradient, Foot motion - Wireless energy transmission - Energy harvesting from light and RF energy - Energy and power consumption issues, Future considerations. (9)

MONITORING PHYSICAL AND PHYSIOLOGICAL PARAMETERS : Wearable sensors for physiological signal measurement - Physical measurement: Cardiovascular diseases, Neurological diseases, Gastrointestinal diseases - Wearable and non-invasive assistive technologies: Assistive devices for individuals with severe paralysis, Wearable tongue drive system, Sensor signal-processing algorithm, Dual-mode tongue drive system. (9)

Total L: 45

TEXT BOOKS:

1. Edward Sazonov, Michael R Neuman , "Wearable Sensors: Fundamentals, Implementation and Applications", Academic Press, USA, 2014.
2. Tom Bruno , "Wearable Technology: Smart Watches to Google Glass for Libraries", Rowman & Littlefield Publishers, Lanham, Maryland, 2015.

REFERENCES:

1. Raymond Tong , "Wearable Technology in Medicine and Health Care", Academic Press, USA, 2018.
2. Haider Raad , "The Wearable Technology Handbook", United Scholars Publication, USA, 2017.
3. Annalisa Bonfiglio, Danilo De Rossi , "Wearable Monitoring Systems", Springer Science & Business Media, USA, 2011.

4. Röcker, Carsten , "Smart Healthcare Applications and Services: Developments and Practices: Developments and Practices", IGI Global, USA, 2010.

19D015 TELEMEDICINE AND HEALTHCARE DELIVERY

3 0 0 3

TELEMEDICINE : Biomedical telemetry - Benefits - Types of telemedicine services - Delivery mechanisms - Challenges in implementing telemedicine - Telemedicine standards and guidelines - Telemedicine System: Process in telemedicine, Parameters, Trends, Delivery modes in telemedicine - Setting up a telemedicine facility. (9)

TECHNOLOGIES : Transmission of data: Audio, Still images, Video - Telemedicine workstation and interfacing techniques - Telecommunication technologies for telemedicine - Networking in telemedicine – Wireless technologies for telemedicine. (9)

APPLICATIONS AND ISSUES : Teleradiology - PACS - Telepathology - Teledermatology - Teleophthalmology -Telecardiology - Telesurgery - Teleoncology - Teleneurology - Teleaudiology - Telepsychiatry - Telerehabilitation - Issues in telemedicine systems: Ethical, Privacy, Security, Legal issues. (9)

MOBILE HEALTHCARE : Key technologies for mHealth - Wireless connectivity in mHealth - Ubiquitous healthcare - WBAN - WPAN - WS N - mHealth in intensive care monitoring - Mobile telemedicine - Telehome care and telehealth: Categories, Technologies, Requirements - Chronic disease management - mHealth Apps and challenges - Personal health monitors. (9)

EHEALTH AND CYBER MEDICINE : Internet and telemedicine - Cyber medicine and telemedicine - Future developments in cyber medicine - Multimedia data exchange - Multipoint video conferencing - Standards and other audio/video interactive system. (9)

Total L: 45

TEXT BOOKS:

1. Khandpur R S , "Telemedicine: Technology and Applications (mHealth, TeleHealth and eHealth)", PHI Learning, New Delhi, 2017.
2. Karen A. Wager, Frances W. Lee, John P. Glaser , "Health Care Information Systems: A Practical Approach for Health Care Management", Jossey-Bass, San Francisco, CA, 2017.

REFERENCES:

1. Victor Lyuboslavsky , "Telemedicine and Telehealth 2.0: A Practical Guide for Medical Providers and Patients", CreateSpace Independent Publishing, USA, 2015.
2. Brown Mary , "Introduction to Healthcare Delivery", Kendall Hunt Publishing, USA, 2012.
3. Norris A C , "Essentials of Telemedicine and Telecare", John Wiley & Sons, England, 2008.
4. Bernard Fong, Fong A C M, Li C K , "Telemedicine Technologies: Information Technologies in Medicine and Telehealth", John Wiley & Sons, United Kingdom, 2011.

19D016 MOBILE APPLICATION DEVELOPMENT

3 0 0 3

INTRODUCTION : Mobile devices and desktop devices - Mobile Architecture and Design guidelines - Power Management - Screen resolution - Touch interfaces - Review of java programming. (9)

MOBILE OS FUNDAMENTALS : Basic Building blocks: Activities, Fragments, Services, Broadcast Receivers & Content provider - UI Components: Views & notifications - Components for communication: Intents & Intent Filters - Activity life cycle - Dalvik Virtual machines - Android Architecture Native vs. web applications - Introduction to Android SDK IDE - hello world programming. (9)

APPLICATION DESIGN : User-interface design for mobile applications - Creating activity - Working with views - Notifications and alarms - Graphics and animations - Storing and retrieving data. (9)

SENSOR INTERFACING : Augmented Reality via GPS - Bluetooth - Accelerometer - Gyroscopes and Camera -Integrating with cloud services - Integration of network, OS and hardware into mobile applications - Case study. (9)

APPLICATION DEVELOPMENT MANAGEMENT : Addressing enterprise requirements in mobile applications: performance, scalability, modifiability, availability and security - Mobile malware, Device protections - Android rooting - Testing methodologies for mobile applications - Publishing - Deployment - Maintenance and management. (9)

Total L: 45

TEXT BOOKS:

1. Reto Meier, Ian Lake , "Professional Android", John Wiley & Sons, California, 2018.
2. Meikang Qiu, Wenyun Dai, Keke Gai , "Mobile Applications Development with Android: Technologies and Algorithms", CRC Press, Florida, 2016.

REFERENCES:

1. G. Blake Meike, Zigurd Mednieks, Masumi Nakamura, Laird Dornin , "Programming Android", O'Reilly, California, 2012.
2. Brain Fling , "Mobile Design and Development: Practical concepts and techniques for creating mobile sites and web app", O'Reilly, California, 2009.
3. Valentino Lee, Heather Schneider, Robbie Schell , "Mobile Applications: Architecture, Design, and Development", Pearson Education, London, 2009.
4. W. Frank Ableson, Robi Sen, Chris King, C. Enrique Ortiz , "Android in Action", Manning Publications, New York, 2012.

19D017 MEDICAL ROBOTICS**3 0 0 3**

INTRODUCTION : Robots and Robotics - Classification of robots - Robot components - Degrees of freedom - Robot joints - Coordinates and frames - Robot characteristics - Workspace and Programming languages – Robot applications. (6)

KINEMATICS AND DYNAMICS OF ROBOTS : Introduction: Robot mechanism , Conventions ,Representations , Transformations - Forward and Inverse Kinematics: Denavit-Hartenberg Convention , Differential relationship , Jacobian , Differential motions of a frame , Lagrangian mechanics - Dynamic equations of multiple DOF robots - Static force analysis of robots. (11)

TRAJECTORY AND PATH PLANNING OF ROBOTS : Introduction: Path Vs Trajectory , Joint space Vs Cartesian Trajectories - Joint space trajectory planning - Cartesian space trajectories - Geometric problems with cartesian paths - Path generation at run time - Planning paths when using the dynamic model - Collision - Free path planning. (11)

MOTION TRACKING AND PREDICTION : Motion correlation - Regression and normal equations - Support vectors Least mean square prediction - Wavelet based LMS Prediction - Performance measures. (7)

APPLICATIONS OF ROBOTICS : Robot assisted laparoscopic surgery - Image Guided Robotic Systems for Surgical Applications - Da vinci Surgical Robotic System - Motion Tracking for Minimally Invasive Robotic Surgery - Telerobotic Surgery - Assistive Robotics for Long Bone Fracture Reduction - Rehabilitation for limbs robots - Neuroprosthetics robots. (10)

Total L: 45**TEXT BOOKS:**

1. John J. Craig , "Introduction to Robotics: Mechanics and Control", Prentice Hall of India, New Delhi, 2018.
2. Achim Schweikard, Floris Ernst , "Medical Robotics", Springer, New York, 2015.

REFERENCES:

1. Jocelyne Troccaz , "Medical Robotics", Wiley-ISTE, USA, 2013.
2. Saeed B Niku , "Introduction To Robotics: Analysis, Systems, Applications", Pearson Education, New Delhi, 2010.
3. Daniel R. Faust , "Medical Robots", The Rosen Publishing Group, New York, 2017.
4. Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani , "Robotics: Modelling, Planning and Control", Springer-Verlag, New York, 2011.

19D018 REHABILITATION ENGINEERING**3 0 0 3**

INTRODUCTION: : Rehabilitation concepts - Engineering concepts: Sensory rehabilitation , Motor rehabilitation, Communication disorders - Examples of rehabilitation engineering. (6)

WHEEL CHAIR ENGINEERING : Categories of wheel chairs - Wheel chair structure and component design - Ergonomics of wheel chair propulsion - Power wheel chair electrical system - Personal transportation - Wheelchair : Standards, Transportation safety. (9)

SENSORY REHABILITATION : Sensory augmentation and substitution: Visual system , Auditory system, Tactual system - Aids for vision and hearing impaired - Automatic speech synthesis and voice recognition – Audiometry and speech therapy aids. (9)

MOTOR REHABILITATION : Orthopedic prosthetics and orthotics in rehabilitation: Fundamentals, Applications - Computer Aided Engineering(CAD) in customized component design - Examples of innovative component design: Intelligent prosthetic knee , Hierarchically controlled prosthetic hand ,Self aligning orthotic knee joint - Externally powered and controlled orthotics and prosthetics: FES systems: Restoration of hand function, Restoration of standing and walking , Hybrid Assistive Systems (HAS) - Active prostheses: Active above knee prosthesis, Myoelectric hand and arm prostheses, MARCUS intelligent hand prosthesis. (12)

COMPUTER APPLICATIONS IN REHABILITATION : Augmentative and Alternative Communication (AAC): Acceleration techniques , User interface , Outputs ,Intervention and training - Computer and web access - Performance measurement - Cost - effectiveness of high vs low technology approaches - Environmental control systems and access to computers - Robotic manipulation aids. (9)

Total L: 45

TEXT BOOKS:

1. Joseph D. Bronzino , "Biomedical Engineering Handbook: Volume II", CRC Press, New York, 2013.
2. Rory A. Cooper , "An Introduction to Rehabilitation Engineering", Taylor and Francis, New York, 2006.

REFERENCES:

1. Randall L.Braddom , "Handbook of Physical Medicine and Rehabilitation", W.B. Saunders Publications, Pennsylvania, 2006.
2. Horia-Nicolai L.T, Lakhmi C.J , "Intelligent Systems and Technologies in Rehabilitation Engineering", CRC Press, New York, 2001.
3. Tan Y. Kheng , "Rehabilitation Engineering", In-Teh, Croatia, 2009.
4. Alex Mihalidis , ""Rehabilitation Engineering Principles and Practice Synopsis"", CRC Press, New York, 2019.

19D019 OCCUPATIONAL BIOMECHANICS AND ERGONOMICS**3 0 0 3**

INTRODUCTION TO ERGONOMICS : Definition of occupational biomechanics - Ergonomic design - Principles of human centered design - Models of human performance: Helson's hypothesis - Trends in industry that impact ergonomic design - Methods of ergonomic analysis. (9)

HUMAN SYSTEM AND DESIGN TO FIT : Anthropometry - Body movement - Sensory subsystem – Support subsystem - Ergonomic design principles - Analysis of task and jobs. (9)

ASSESSMENT AND DESIGN OF PHYSICAL ENVIRONMENT : Cleanliness - Clutter and disorder - Temperature and humidity - Lighting and illumination: Luminous environment and measurement, Lighting methods, Principles of lighting design - Noise: Health effect on noise, Annoyance and other effect of noise, Noise control strategies, Hearing protection. (9)

DESIGN OF TOOLS AND EQUIPMENTS : Design of seating - Hands and handedness - Techniques for determining hand tool adequacy - Power tools - Point of operation hazards - Protective equipment for the operator Accommodation strategy for handicapped people. (9)

ERGONOMICS OF PRODUCT QUALITY AND USABILITY : Quality management and customer driven design: Identifying customer requirement, Specifying design requirement, Prototyping and testing - Usability analysis and testing: Task analysis method, Expert evaluation - Experiments involving humans: Independent variables, Dependent variables, Basic experimental designs. (9)

Total L: 45**TEXT BOOKS:**

1. Mark R Letho, James R Buck , "Introduction to Human Factors and Ergonomics for Engineers", CRC press, New York, 2012.
2. Gavriel Salvendy , "Handbook of Human Factors and Ergonomics", John Wiley and Sons, New Jersey, 2012.

REFERENCES:

1. Shrawan Kumar , "Biomechanics in Ergonomics", Taylor and Francis, London, 2001.
2. Martin Helander , "A Guide to the Ergonomics of Manufacturing", Taylor and Francis, London, 2001.
3. Neville Morray , "Ergonomics: Physiological Mechanisms and Models in Ergonomics", Taylor and Francis, London, 2005.
4. Christopher M Schlick , "Industrial Engineering and Ergonomics", Springer, Germany, 2009.

19D020 PATTERN RECOGNITION AND NEURAL NETWORKS**3 0 0 3**

INTRODUCTION : Classification: Classification Process - Features - Training and Learning - Supervised Learning and Algorithm Selection - Approaches to Classification- Applications. (7)

PARAMETRIC & NON PARAMETRIC LEARNING : Parametric Learning: Bayesian Decision Theory, Discriminant Functions and Decision Boundaries - Nonparametric Learning: Parzen Window, k-Nearest Neighbor (kNN) Classification. (10)

FEATURE EXTRACTION AND SELECTION : Reducing Dimensionality: Pre-processing - Feature Selection: Inter/ Intra-class Distance - Subset Selection - Feature Extraction - Principal Component Analysis - Independent Component Analysis - Linear Discriminant Analysis - Genetic Algorithm. (10)

NEURAL NETWORKS : Introduction: Difference between biological and artificial neural networks, Architecture, Activation functions - Single layer perceptron - Multilayer perceptron - Back propagation algorithm - Hopfield's network - Kohonen's self organizing maps - Adaptive resonance theory. (10)

NEURAL NETS FOR PATTERN CLASSIFICATION : Architecture: Biases and threshold - Linear Separability - Data Representation - Hebb Net: Algorithm - Applications, Perceptron: Architecture - Algorithm - Applications, Adaline: Architecture - Algorithm - Applications, Madaline - Neural Network Optimization using Genetic Algorithm. (8)

Total L: 45

TEXT BOOKS:

1. Geoff Dougherty , "Pattern Recognition and Classification: An Introduction", Springer, USA, 2017.
2. Laurene V. Fausett , "Fundamental of Neural Networks, Architectures, Algorithms and Applications", Pearson Education, New Delhi, 2011.

REFERENCES:

1. Richard O. Duda, P.E. Hart, D.G Stork , "Pattern Classification", John Wiley & Sons Inc, New Delhi, 2012.
2. Rajasekaran S, Vijayalakshmi Pai G A , "Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and Applications", PHI Learning Pvt. Ltd, New Delhi, 2014.
3. Christopher M.Bishop , "Pattern Recognition and Machine Learning", Springer, USA, 2013.
4. Narasimha Murty M, Susheela Devi V , "Pattern Recognition: An Algorithmic Approach", University Press, New Delhi, 2011.

19D021 ADVANCED DIGITAL SIGNAL PROCESSING**3 0 0 3**

MULTIRATE SIGNAL PROCESSING : Representation of discrete signals - Down sampling - Up sampling - Noble identities - Cascading sampling rate convertors - Decimation with transversal filters - Interpolation with transversal filters - Decimation with polyphase filters - Interpolation with polyphase filters - Decimation and Interpolation with rational sampling factors -Multistage implementation of sampling rate convertors. (12)

FILTER BANKS : Two channel filter banks - QMF filter banks - Perfect Reconstruction Filter banks - Filter banks with tree structure and parallel structure - DFT filter Banks. (9)

MULTI RESOLUTION ANALYSIS : Definition - Construction of general orthonormal MRA - Wavelet basis: Harr-properties- Scalogram - Application of wavelets in denoising. (8)

POWER SPECTRUM ESTIMATION : Parametric methods :Auto Regressive (AR) spectrum estimation - Relationship between auto correlation and model parameters - Moving Average (MA) and Auto Regressive Moving Average (ARMA) spectrum estimation. - Time Series Analysis. (8)

ADAPTIVE FILTERS : Introduction - FIR adaptive filters: Steepest descent adaptive filter - The LMS algorithm - Convergence of LMS algorithm - Adaptive recursive filters - The RLS algorithm - Adaptive Interference Cancellation. (8)

Total L: 45**TEXT BOOKS:**

1. Vikram Gadre, Aditya Abhyankar , "Multiresolution and Multirate Signal Processing: Introduction, Principles and Applications", McGraw Hill Education, India,Chennai, 2017.
2. Alan V. Oppenheim and Ronald W. Schafer , "Digital Signal Processing", Pearson Education, Harlow, 2014.

REFERENCES:

1. Jose Luis Rojo-Alvarez, Manel Martinez-Ramon, "Digital Signal Processing with Kernel Methods", Wiley&Sons, New York, 2018.
2. Proakis J G and Manolakis D G , "Digital Signal Processing Principles, Algorithms and Applications", Pearson Education Ltd, London, 2014.
3. Benesty J, Huang Y , "Adaptive Signal Processing: Applications to Real-world Problems", Springer, London, 2011.
4. S G Mallat , "A wavelet tour of signal processing : the Sparse way", Academic Press, Boston, 2009.

19D022 DATABASE MANAGEMENT SYSTEMS**3 0 0 3**

INTRODUCTION AND CONCEPTUAL MODELING : Databases and database users - Database system concepts and architecture - Data modeling using entity relationship model - Enhanced entity relationship model. (9)

RELATIONAL MODEL AND DATABASE DESIGN : Relational data model - Database design by Entity Relationship diagrams (ER) and Enhanced ER to relational mapping - SQL - Functional dependencies - Axioms - Normal Forms: First normal form, Second normal form, Third normal form, Boyce Codd normal form - Multi-valued dependency - Join dependency. (9)

DATA STORAGE AND INDEXING : Introduction - Record storage - Primary file organization - Index structures for files: Single level Indexing - Multilevel Indexing. (9)

BIOINFORMATIC DATABASES : Sequence databases - Phylogenetic databases - Structure and pathway - Microarray and boutique databases. (9)

BIOLOGICAL DATA INTEGRATION : Data cleaning - Case study in biological data cleaning - General data integration - Biological data integration. (9)

Total L: 45

TEXT BOOKS:

1. Ramez Elmasri and Shamkant B Navathe , "Fundamentals of Database Systems", Pearson Education, England, 2016.
2. Kevin Byron, Katherine G Herbert, Jason T.L.Wang , "Bioinformatics Database Information Systems", CRC press, Boca Raton, 2017.

REFERENCES:

1. Date C J, Kannan A, Swamynathan S , "An Introduction to Database Systems", Pearson Education, New Delhi, 2018.
2. Raghu Ramakrishnan, Johannes Gehrke , "Database Management Systems", McGraw Hill, New Delhi, 2014.
3. Abraham Silberschatz, Henry F Korth, Sudharshan S , "Database System Concepts", Tata McGraw Hill, New Delhi, 2015.
4. Claudia Plant and Christian Bohm , "Database Technology for Life Sciences and Medicine", World Scientific, Singapore, 2010.

19D023 ARTIFICIAL INTELLIGENCE

3 0 0 3

INTRODUCTION : History - Difference between Machine Learning and AI - Intelligent agents - Agent based system -Structure of Agents - Problem Formulation. (8)

SEARCH STRATEGIES : Breadth-First Search - Uniform Cost Search - Depth-First Search - Depth-Limited Search Iterative Deepening Search - Bidirectional Search - Heuristic Search Techniques - A* Search - AO* Algorithm. (9)

KNOWLEDGE REPRESENTATION AND REASONING : Knowledge representation: Logics, First order logic, Inference in first order logic, Higher order logic - Reasoning with Default Information: Truth Maintenance Systems, Acting under Uncertainty, Certainty Factors and Rule Based Systems, Dempster-Shafer Theory. (9)

NATURAL LANGUAGE PROCESSING : Phases: Syntactic Processing, Semantic Analysis, Discourse and Pragmatic Processing - Learning: Supervised Learning, Unsupervised learning, Reinforced learning. (9)

EXPERT SYSTEMS : Overview - Components, Knowledge-Based Expert System (KBES) - Architecture of KBES -Applications: Prospector – Mycin. (10)

Total L: 45

TEXT BOOKS:

1. Stuart Russell, Peter Norvig , "Artificial Intelligence: A Modern Approach", Pearson Education, New Delhi, 2016.
2. Elaine Rich, Kevin Knight , "Artificial Intelligence", Tata McGraw Hill Publishing Company, New Delhi, 2014.

REFERENCES:

1. Dan W Patterson , "Introduction to AI and Expert Systems", Prentice Hall of India, New Delhi, 2010.
2. David Pool, Alan Mackworth , "Artificial Intelligence: Foundations of Computational Agents", Cambridge University, New Delhi, 2011.
3. Eugene Charniak, Drew McDermott , "Introduction to Artificial Intelligence", Pearson Education, New Delhi, 2010.
4. C.S. Krishnamoorthy, S. Rajeev , "Artificial Intelligence and Expert Systems for Engineers", CRC Press, Florida, 2018.

19D024 ADVANCED MACHINE LEARNING

3 0 0 3

BASICS OF MACHINE LEARNING : Supervised - Unsupervised - Learning methods - Linear and Non-linear methods - Spaces - Complexity - Dimensionality - VC-dimension computation - bounds and details - PAC learning - Deep learning. (9)

PROBABILITY ESTIMATES : Generalization and Over fitting - Regularization - Validation - Maximal Likelihood and Maximum a posteriori methods - Maximum Entropy methods - Structured Support Vector Machines. (9)

DETAILED GRAPHICAL MODELS : Bayesian Networks - Hidden Markov Models - Markov Random Fields Conditional Random Fields - Generalizations of SVD - LSA - pLSA - LDA - Chinese Restaurant Analysis. (9)

TIME SERIES PROCESSING : Preprocessing - Similarity measures - Motif Discovery in Bio-signals. (8)

LEARNING TECHNIQUES : Convolution Neural Networks (CNN) - Recurrent Neural Networks (RNN) - Bagging and Boosting - Semi-supervised learning - Reinforcement learning - Transfer learning. (10)

Total L: 45

TEXT BOOKS:

1. Duda R. O., Hart P.E., Stork D. G. , " Pattern Classification", John Wiley & Sons, New Jersey, 2001.
2. Alpaydin E. , "Introduction to Machine Learning ", The MIT Press, Massachusetts, 2014.

REFERENCES:

1. Sutton R.S., Barto, R.G. , "Reinforcement Learning:An Introduction", The MIT Press, Massachusetts, 2012.
2. Bishop C. M. , "Pattern Recognition and Machine Learning", Springer Information Science and Statistics, USA, 2007.
3. Shawe-Taylor J. & Cristianini N. , "Kernel Methods for Pattern Analysis", Cambridge University Press, Cambridge, 2004.
4. Hastie, T., Tibshirani R., Friedman J. H. , "The Elements of Statistical Learning: Data Mining, Inference and Prediction", Springer, USA, 2001.

19D025 SECURITY FOR MEDICAL DEVICES**3 0 0 3**

INFORMATION SECURITY FUNDAMENTALS: Overview of security principles- Threats - Attacks - Vulnerabilities-Classical cryptosystem–Symmetric key and public key cryptosystem–Data Integrity- Sources of threats- Attack vectors- Data breach – Hacking –Malware,Overview of Health IT System: Impact of Health IT Components on Patient Safety,Risk management: Factors Important to Medical Device Risk Assessment. (9)

NETWORKING AND COMMUNICATION FOR HEALTHCARE EQUIPMENT: Device Classification : Class I, II and III, Hardware and Physical Interface Security, Network Architecture, Network Security, Security at the Transport Layer: SSL and TLS Protocol, Host Intrusion detection and prevention systems,Firewalls, Security Management tools. (9)

SECURITY STANDARDS IN HEALTHCARE: Medical Device QMS ISO 13485, Risk management of medical devices ISO 14971, IEC 62304 Software development life cycle process, UL-2900-1 Cybersecurity Standard for Medical Devices, Secure Exchange of Electronic Health Records , Medical Devices Directive : In Vitro Diagnostic Medical Device and Directive Regulation (IVDR), Medical Device and Directive Regulation (MDR). (9)

SECURITY IN WIRELESS DEVICES: Wireless Implantable Devices, Security issues in Implantable Devices, Attack Model, Patient Access Pattern based defence scheme, Performance Evaluation, Wireless patient monitoring, Buildingsecure 802.11 Wireless LAN networks. (9)

SECURITY IN INTERNET OF THINGS: Cyber Security versus IoT security – IoT attacks and Countermeasures – Common IoT attack types, Attack trees, Fault trees and CPS-Attacks, Wireless reconnaissance and mapping, Security Protocol attacks, Physical security attacks, Application security attacks - Security Engineering for IoT Development. (9)

Total L : 45**TEXT BOOKS:**

1. Axel Wirth, Christopher Gates, Jason Smith, " Medical Device Cybersecurity: A Guide for Engineers and Manufacturers", Artech House, Massachusetts, 2020.
2. Forouzan, Behrouz A., Debdeep Mukhopadhyay, "Cryptography and network security", McGraw-Hill Education, New Delhi, 2011.

REFERENCES:

1. Richard Fries, "Reliable Design of Medical Devices", CRC Press, Boca Raton, 2006.
2. XialiHei, Xiaojiang Du, "Security in Wireless Implantable Devices", Springer Briefs in Computer Science, Springer-Verlag, New York,2013.
3. Shancang Li, Li Da Xu, "Securing the Internet of Things", Elsevier,USA, 2017.
4. Chryssanthou Anargyros, Apostolakis Ioannis, Varlamis Iraklis (Eds.), "Certification and Security in Health-Related Web Applications: Concepts and Solutions", Medical Information Science Reference, 2010.

19D026 COMPUTER AIDED DRUG DESIGN**3 0 0 3**

INTRODUCTION:Introduction to Artificial Intelligence and Chemistry-Artificial Intelligence in History-Chemistry Finding Artificial Intelligence-Synthesis Planning-Predictive Modeling of Properties. (7)

CHEMICAL TOPIC MODELING:Topic Modeling & LDA:Mathematical Framework of LDA, Advanced Topic Modeling Extensions,Topic Modeling relation to Machine learning methods,Chemical Topic Modeling:Feature representation for Chemical Topic Modeling,Creating and Interpretation of Chemical Topic Model. (10)

COMPUTATIONAL DRUG DISCOVERY: Conformal Prediction Modalities:Inductive Conformal Prediction(ICP)-Handling Imbalanced Dataset:ICP for Regression-Conformal Prediction methods for Deep Learning-Open-source Implementation of Conformal Prediction-Deep learning Case Study: Spectroscopic Analysis, Natural Language Processing. (10)

STRUCTURE-BASED PREDICTIVE MODELING: Predicting Protein-ligand Binding Affinities: Potential Based Method, Simulation Based Method, Data-Based Method- Modern Machine learning Scoring Functions: Domain Applicability, Descriptors, Models, Interpretability, Implementation & Availability. (9)

MOLECULAR DYNAMICS SIMULATION USING MACHINE LEARNING: Basics of Molecular Dynamics: Machine –learning Applications-Using Machine learning to Improve Force Fields: Multi-Variate Linear Regression, Bayesian Inference, Genetic Algorithm, Random Forest Regression- Improving Sampling in MD Simulations: General Sampling Enhancement-Learning from MD Trajectories: Application to Clustering. (9)

Total L:45

TEXT BOOKS:

1. Nathan Brown, "Artificial Intelligence in Drug Discovery", Royal Society of Chemistry, UK, 2020.
2. Adam Bohr, Kaveh Memarzadeh, "Artificial Intelligence in Healthcare", Elsevier, UK, 2020.

REFERENCES:

1. Richard B. Silverman, Mark W. Holladay, "Organic Chemistry of Drug Design and Drug Action", Academic Press, USA, 2014.
2. Siddiqui A.A, "Computer Aided Drug Design (HB 2020)", CBS Publishing, New Delhi, 2020.
3. Mohane S. Coumar, "Molecular Docking for Computer-Aided Drug Design: Fundamentals, Techniques, Resources and Applications", Academic Press Inc, New Delhi, 2021.
4. Dev Bukhsh Singh, "Computer-Aided Drug Design", Springer, USA, 2020.

LANGUAGE ELECTIVES

19G001 COMMUNICATION SKILLS FOR ENGINEERS

0 0 4 2

COMMUNICATION CONCEPTS :

Process of Communication
Inter and Intrapersonal Communication
Inter and Intrapersonal Communication Activities

(9)

FOCUS ON SOFT SKILLS :

Etiquette — Work Place etiquette — Telephone etiquette
Body Language
Persuasive Communication
Public Speaking
Critical Reasoning and Conflict Management based on Case Studies
Group Communication
Meetings
Interview Techniques

(14)

TECHNICAL WRITING :

Technical Writing Principles
Style and Mechanics
Technical Definitions – Physical, Functional and Process Descriptions
Technical Report Writing
Preparing Instructions and Manuals
Interpretation of Technical Data

(15)

BUSINESS CORRESPONDENCE :

Writing Emails
Preparing Resumes
Memos
Technical and Business Proposals

(7)

TECHNICAL COMMUNICATION :

Seminars
Process Description and Group Discussions
Use of Visual Aids

(15)

Total P: 60

TEXT BOOKS:

1. Faculty Incharge "Course Material on "Communication Skills for Engineers"", PSG College of Technology., Coimbatore, 2019

REFERENCES:

1. Jeff Butterfield "Soft Skills for Everyone", Cengage Learning., New Delhi, 2013
2. Jean Naterop B and Rod Revell "Telephoning in English", Cambridge University Press., Cambridge, 2011
3. David A Mc Murrey and Joanne Buckley "Handbook for Technical Writing", Cengage Learning., New Delhi, 2011
4. Simon Sweeney "English for Business Communication", Cambridge University Press., New Delhi, 2012

19G002 GERMAN- LEVEL A1.1**0 0 4 2****GUTEN TAG! :**

1. To greet, learn numbers till 20, practice telephone numbers & e mail address, learn alphabet, speak about countries & languages
 2. Vocabulary: related to the topic
 3. Grammar: W — Questions, Verbs & Personal pronouns I.
- (10)

FREUNDE, KOLLEGEN UND ICH :

1. To speak about hobbies, jobs, learn numbers from 20; build dialogues and frame simple questions & answers
 2. Vocabulary: related to the topic
 3. Grammar: Articles, Verbs & Personal pronouns II, sein & haben verbs, ja/nein Frage, singular/plural
- (10)

IN DER STADT :

1. To know places, buildings, question, know transport systems, understand international words; build dialogues and write short sentences
 2. Vocabulary: related to the topic
 3. Grammar: Definite & indefinite articles, Negotiation, Imperative with Sien verbs
- (12)

GUTEN APPETIT! :

1. Tospeak about food, shop, converse; Vocabulary: related to the topic; build dialogues and write short sentences
 2. Grammar: Sentence position, Accusative, Accusative with verbs, personal pronouns & prepositions, Past tense of haben & sein verbs
- (13)

TAG FÛR TAG/ZEIT MIT FREUNDEN :

1. To learn time related expressions, speak about family, about birthdays, understand & write invitations, converse in the restaurant; ask excuse, fix appointments onphone
 2. Vocabulary: related to the topic
 3. Grammar: Time related prepositions, Possessive articles, Modalverbs
- (15)

Total P: 60**TEXT BOOKS:**

1. Dengler Stefanie "Netzwerk A1.1", Klett-Langenscheidt GmbH., München,2013
2. Sandra Evans, Angela Pude "Menschen A1", Hueber Verlag., Germany, 2012

REFERENCES:

1. Stefanie Dengler "Netzwerk A1", Klett-Langenscheidt GmbH., München, 2013
2. Hermann Funk, Christina Kuhn "Studio d A1", Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2009
3. Rosa-Maria Dallapiazza "Tangram Aktuell 1 (Deutsch als Fremdsprache)", Max Hueber Verlag., Munchen, 2004
4. Christiane Lemcke und Lutz Rohrmann "'Grammatik Intensivtrainer A 1", Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2012

19G003 FRENCH LANGUAGE LEVEL 1**0 0 4 2****PARTS OF SPEECH :**

1. inviter et répondre à une invitation, Pronoms sujets
2. L'article définis, l'article indéfinis

3. Conjugation : présent, adjectifs possessifs
 4. interrogation, décrire les personnes
 5. La vie de quatre parisiens de professions différentes
- (12)

ELEMENTS OF GRAMMAR :

1. Exprimer l'ordre et l'obligation demander et commander
2. l'adjectif possessifs, l'article partitif, l'article démonstratif, négation ne
3. pas, l'article contracté
4. verbe pronominaux
5. prepositions

(12)

SENTENCE STRUCTURE :

1. Raconter et reporter-donner son avis
2. Futur simple, pronom complètement d'objet direct, passé composé
3. plusieurs région de France, imparfait, pronom y/en, imparfait

(12)

TENSES AND NUMBERS :

1. Demander l'autorisation-passé récent, futur proche
2. La vie administrative et régionale, Pluriel des noms, moyens de transport

(12)

DISCOURSE :

1. le discours rapporté, décrire un lieu, exprimer ses préférences
2. décrire la carrière, discuter d'un système éducation de France
3. parler de la technologie de l'information

(12)

Total P: 60

TEXT BOOKS:

1. Christine Andant étal "À propos (livre de l'élève", LANGER., NEW DELHI, 2012
2. Myma Bell Rochester "Easy French Step By Step", MCGrawhill Companies., USA, 2008

REFERENCES:

1. Michael D. Oates "Entre Amis: An Interactive Approach", Houghton Mifflin., 2005 , 5th
2. Bette Hirsch, Chantal Thompson "Moments Literaries : An Anthology for intermediate French", ..
3. Simone Renaud, Dominique van Hooff "En bonne forme", ..

19G004 BASIC JAPANESE

0 0 4 2

JAPANESE PEOPLE AND CULTURE :

1. Basic greetings and responses
2. Basic script— Method of writing hiragana and katakana —Combination sounds and simple words
3. Self introductions: "Hajimemashite" -Demonstratives "Kore", "Sore", "Are"— Demonstrative "Kono", "Sono", "Ano"
4. Possessive noun particle "no"— Japanese apartments: Greeting your neighbor

(12)

PARTICLE "NI (AT)" FOR TIME :

1. kara (from) ~ made(until) — Particle "to (and)"
2. Time periods: Days of the week, months, time of day –Verbs (Present / future and past tense)
3. Telephone enquiry: Asking for a phone no. And business hours- Destination particle "e".

(12)

LIKES AND DISLIKES :

1. Potential verbs (wakarimasu and dekimasu) — "Kara (~ because)"
2. Adverbs — Asking some one out over the phone-Verbs denoting presence
3. Introduction to Adjectives (na and ii type) -Verb groups — I, II and III — Exercises to group verbs- Please do (te kudasai)
4. Present continuous tenses (te imasu) — Shall I? (~ mashou ka) — Describing a natural phenomenon (It is raining)

(12)

DIFFERENT USAGES OF ADJECTIVES :

1. Comparison — Likes and dislikes — Going to a trip- Need and desire (ga hoshii) — Wanting to . . . (Tabetai desu)- Going

- for a certain purpose (mi –ni ikimasu)
2. Choosing from a menu-Adjectives (“i” and “na” type) — Adjectives (Positive and negative useage) (12)

ROLE PLAYS IN JAPANESE :

1. Framing simple questions & answers
2. Writing Short paragraphs & Dialogues
3. A demonstration on usage of chopsticks and Japanese tea party (12)

Total P: 60

TEXT BOOKS:

1. Minna no Nihongo, Honsatsu Roma "ji ban (Main Textbook Romanized Version)", . International publisher — 3A Corporation., Tokyo,2012

REFERENCES:

1. Eri Banno et.al "Genki I: An Integrated Course in Elementary Japanese I -Workbook", ., 1999
2. Tae Kim "A Guide to Japanese Grammar: A Japanese Approach to Learning Japanese Grammar", ., 2014
3. Minna No Nihongo "Translation & Grammatical Notes In English Elementary", .,

ONE-CREDIT COURSES

19DF01 RADIATION PROTECTION IN MEDICAL TECHNOLOGY

1 0 0 1

BIOLOGICAL EFFECTS OF RADIATION : Interaction of radiation with matter, the importance of these interactions in diagnostic radiology and radiation oncology-Biological effects with examples-Exposure, Kerma, Dose equivalents and their estimation. (5)

RADIATION PROTECTION, DETECTION AND MONITORING : Types of radiation exposures, Principles of radiation protection, Operational dose limits- Radiation Hazards Control-Detection principles-Radiation protection monitors. (5)

SAFETY ASPECTS AND EMERGENCY HANDLING : Regulatory Requirements-Installation safety, Equipment safety-Radiation warning signs-Radiation accidents in Radiation Therapy & Handling Emergencies. (5)

Total L: 15

TEXT BOOKS:

1. Khan F M , "The Physics of Radiation Therapy", Lippincott Williams & Wilkins, 2014.
2. E.B. Podgorsak , "Radiation Oncology Physics: A Handbook for Teachers and Students", International Atomic Energy Agency, Vienna, 2005.

REFERENCES:

1. Mary Alice Statkiewicz Sherer, Paula J. Visconti, E. Russell Ritenour, Kelli Welch Haynes , "Radiation Protection in Medical Radiography", 7th Edition, Elsevier, Maryland Heights, 2014.

19DF02 RADIATION ONCOLOGY PHYSICS

1 0 0 1

PRINCIPLES OF RADIATION ONCOLOGY PHYSICS : Introduction to external beam therapy physics and brachytherapy physics. (1)

BASIC RADIATION PHYSICS : Structure of atom, nucleus - phenomenon of radioactivity - radioactive emissions,properties - Bremsstrahlung emission: kV, MV regions - radiation sources used in radiation oncology: preparation, usage. (2)

EQUIPMENT IN RADIATION ONCOLOGY : Design of kV, MV, Co-60, HDR RAL (high dose rate remote after loading) treatment, delivery systems, radiation characteristics, clinical use of the equipment. (3)

CLINICAL DOSIMETRY : Concept of charged particle equilibrium - Measurement of air kerma and dose: free air chamber, cavity chamber, ionization chamber, calorimeter - clinical dosimeters: TLD, semiconductor dosimeters - Calibration. (3)

TREATMENT PLANNING : Localization - Percentage depth dose - TAR/TMR: use in SSD/SAD type of treatments - cross beam profiles - isodose curves - beam modifications: wedges, compensators, bolus - 2D planning. (4)

TREATMENT : Time/MU calculations, delivery, verification. (2)

Total L: 15

TEXT BOOKS:

1. Edward C. Halperin, Carlos A. Pérez, Luther W. Brady , "Perez and Brady's Principles and Practice of Radiation Oncology", Lippincott Williams & Wilkins, Philadelphia, 2008.
2. Murat Beyzadeoglu, Gokhan Ozyigit, Cuneyt Ebruli , "Basic Radiation Oncology", Springer, New York, 2010.

REFERENCES:

1. Pam Cherry, Angela Duxbury , "Practical Radiotherapy Physics and Equipment", Wiley - Blackwell, New Jersey, 2009.
2. Faiz M. Khan , "The Physics of Radiation Therapy", Lippincott Williams & Wilkins, Philadelphia, 2009.

19DF03 RESPIRATORY PHYSIOLOGY**1 0 0 1****INTRODUCTION** : Introduction to respiratory system - mechanics of respiration. (3)**BASIC PHYSIOLOGY** : Respiratory membrane - pulmonary circulation-transport: oxygen, carbon-dioxide - regulation of respiration. (4)**FUNCTIONAL PARAMETERS** : Gas exchange - ventilation perfusion ratio - pulmonary function test. (2)**ADVANCED PHYSIOLOGY** : High altitude physiology - deep sea physiology - hypoxia and artificial respiration - oxygen therapy -respiratory changes following exercise. (4)**RESPIRATORY AID** : Ventilators. (2)**Total L: 15****TEXT BOOKS:**

1. Arthur C Guyton, John E.Hall , "Textbook of Medical Physiology", Saunders Elsevier, Pennsylvania, 2005.
2. William Owens , "The Ventilator Book", First Draught Press, 2012.

REFERENCE:

1. Andrew Davies, G H Blakeley , "Andrew Davies Human Physiology", Churchill Livingstone Publishers, Philadelphia, 2001.

19DF04 SPEECH PRODUCTION AND PROCESSING**1 0 0 1****INTRODUCTION** : Introduction to Speech - Language and Communication Components of speech – Language. (2)**ACOUSTIC THEORY OF SPEECH PRODUCTION:** : Sound production mechanisms of the human vocal tract -Vowels and Consonants - Acoustic theory - Articulatory properties, sound propagation - Vocal tract models - Various types of spectrograms. (2)**SPEECH PERCEPTION** : Speech Chain - Range of human hearing - Auditory mechanisms - Speech perception - Sound and word perception in noise - Perception and intelligibility. (3)**ANALYSIS OF SPEECH** : Time domain and frequency domain representation - Acoustic analysis – Fundamental frequency and Intensity measurement techniques. (3)**NEED FOR DSP** : Various applications including assessment of speech pathology - Infant cry analysis - Forensic speech science - Speech coding - Speech synthesis - Speech recognition and understanding - Speech enhancement and others. (5)**Total L: 15****TEXT BOOKS:**

1. Amalia Bar-On, Dorit Ravid, Elitzur Dattner , "Handbook of Communications Disorders: Theoretical, Empirical, and Applied Linguistic Perspectives", De Gruyter Mouton, Boston, 2018.
2. Thomas F.Quateri , "Discrete-Time Speech Signal Processing: Principles and Practice", Prentice Hall, New Jersey, 2008.

REFERENCE:

1. Palani S, Kalaiyarasi D , "Digital Signal Processing", Abe Books Pri. Ltd., New Delhi, 2010.

19DF05 MEDICAL TEXTILES**1 0 0 1****INTRODUCTION TO MEDICAL TEXTILES** : Medical textile products and their applications - Sutures - Bandages - Surgical implants - Non surgical implants - Extracorporeal devices - Health care products - Hygiene product – Non woven technology -

Medical textile testing. (6)

COATING IN MEDICAL TEXTILES : Fabric coating: Properties, Polymer coatings, Coating methods, Medical applications - Lamination: Methods and applications. (4)

FACE MASK : Safety issues - Effectiveness - Types - Recommendations - Production & testing . (3)

ELECTROSPUN NANOMEMBRANES FOR MEDICAL APPLICATIONS : Process - Parameters - Polymers used and medical applications. (2)

Total L: 15

REFERENCES:

1. Volkmar T. Bartels , "Handbook of Medical Textiles", Woodhead Publishing Limited, UK, 2011.
2. Subhash Anand , "Medical and Healthcare textiles", Woodhead Publishing Limited, UK, 2010.

19DF06 MEDICAL REGULATORY STANDARDS

1 0 0 1

INTRODUCTION : Overview of medical device quality management system, Introduction to Clauses in ISO 13485 standards. (2)

QUALITY MANAGEMENT SYSTEM : Covering requirements, Case study & exercise. (2)

MANAGEMENT RESPONSIBILITY : Covering requirements, Case study & exercise. (2)

RESOURCE MANAGEMENT : Covering requirements, Case study & exercise. (2)

PRODUCTION REALIZATION : Covering requirements, Case study & exercise. (2)

MEASUREMENT, ANALYSIS & IMPROVEMENT : Covering requirements, Case study & exercise. (2)

STEPS TOWARDS IMPLEMENTATION : Brief about adequacy, Compliance, Gap Analysis, Implementation & Audits. (3)

Total L: 15

TEXT BOOK:

1. Ramakrishna S, Tian L, Wang C, Liao S, Teo WE , "Medical devices: regulations, standards and practices", Woodhead Publishing, 2015.

REFERENCE:

1. Ogrodnik PJ , "Class 1 Devices: Case Studies in Medical Devices Design", Academic Press, 2014.

19DF07 DATA MINING IN HEALTHCARE

1 0 0 1

CONCEPT OF DATA MINING : Knowledge representations and deduction inferences, Uncertainties and reasoning in medicine, data cleaning and data preprocessing. (2)

INTRODUCTION TO STATISTICAL COMPUTING : Statistical analysis and characterization of healthcare data, Descriptive statistics, Statistical R package. (3)

TECHNIQUES OF DATA MINING : Graph models and Bayesian networks, Statistics and hypothesis testing, Regression analysis, Support vector machine, Decision trees and lazy learning, Association rules, Clustering, Temporal data mining and sequential analysis in Biomedicine. (6)

APPLICATIONS : Biomedical sensor analysis, Cloud data analysis, Data mining in medical images, Query Based Image Content, Text mining in Electronic Health Records. (4)

Total L: 15

TEXT BOOKS:

1. Hastie, Tibshirani, Friedman , "The Elements of Statistical Learning", Springer Series in Statistics, 2013.
2. Jain Pei, Jiawei Han, Micheline Kamber , "Data Mining: Concepts and Techniques", Elsevier, 2011.

REFERENCES:

1. T. Mitchell , "Machine Learning", McGraw-Hill Series in Computer Science, 1997.
2. Tadeusz Czachorski, Stanislaw Kozielski, Urszula Stanczyk , "Man-Machine Interactions 2", Springer, 2011.

19DF08 INTERNET OF THINGS FOR HEALTHCARE

1 0 0 1

INTRODUCTION TO IOT AND CC3200 : Introduction to Internet of Things (IoT), Review of CC3200 core and its architecture, Introduction to advanced ARM Cortex M4 architecture, Peripherals overview, User API, Power challenges with IoT, CC3200 Simplelink applications, Starting with Code Composer Studio V6. Various wireless protocols and its applications: ZigBee, Bluetooth Low Energy, 6LowPAN, Wi-Fi. (4)

SIMPLELINK WI-FI CPU : Introduction to CC3200 Simplelink Wi-Fi MCU, hardware Functional Block Diagram, Embedded Software Overview, TI-RTOS support for CC3200 Simplelink, TI-RTOS configuration for CC3200 Simplelink, Simplelink Wi-Fi certification, Power Modes. Introduction to WLAN, WLAN parameters, AP/STATION modes and its Security types, Socket connection, WLAN AP and WLAN STATION configuration settings. (4)

SOFTWARES : Introduction to Pin-Mux Tool, Configuration with Pin-Mux Tools, Introduction to Uniflash, Debugging with Uniflash Tools, HTML page Download. (2)

CASE STUDIES AND DEMONSTRATION : Review of User APIs for TI CC3200 & Initialization and Setting of IP addresses - GPIO, PWM Experiments - Setting up the CC3200 as a HTTP Web server - Automation system using the I/O port thru IP based system - Nursing Station Automation using CC3200 - Alarm System Example using CC3200 - Temperature Monitoring and control application using CC3200 - Sending automated E-mail alerts - Getting Information from Cloud Server - Sending sensor value to the cloud server and controlling the system from cloud. (5)

Total L: 15

TEXT BOOKS:

1. Jonathan W Valvano , "Introduction to Arm(r) Cortex -M Microcontrollers", Createspace, South Carolina, 2012.
2. Samuel Greengard , "The Internet of Things", The MIT Press, Cambridge, 2015.

REFERENCE:

1. Andrew Sloss, Dominic Symes, Chris Wright , "ARM System Developer's Guide: Designing and Optimizing System Software", Morgan Kaufmann Publishers, Burlington, 2004.

19DF09 BIOPOLYMERS IN BIOMEDICAL APPLICATIONS

1 0 0 1

INTRODUCTION : Introduction to Polymer technology - Polymerisation and Basic Structure. (1)

POLYMERS USED AS BIOMATERIALS: Polyvinylchloride(PVC) – Polyethylene(PE) – Polypropylene(PP) - Polymethylmetacrylate (PMMA) - Polystyrene (PS) and Its Copolymers .(2)

BIODEGRADABLE POLYMERS: Polylactide (PLA), Polyglycolide (PGA), Poly(glycolide co-lactide) (PLGA), Poly(dioxanone), Poly(trimethylenecarbonate),Poly(carbonate) - Surface modifications for improving biocompatibility. (4)

BIOPOLYMERS : Classification - Structure - Uses - Environmental benefits. (4)

POLYMERS FOR MEDICAL AND TISSUE ENGINEERING APPLICATIONS : Medical, Dental and Pharmaceutical applications. (4)

Total L: 15

REFERENCES:

1. Michael Niaounakis , "BioPolymers: Applications and Trends", William Andrew, Elsevier, UK, 2015.
2. Susheel Kalia, Luc Averous , "Biopolymers: Biomedical and Environmental Applications", Wiley, Massachusetts, 2011.

ENGLISH

19GF01 INTERPERSONAL AND ORGANIZATIONAL COMMUNICATION

1 0 0 1

INTRA ORGANIZATIONAL COMMUNICATION : Communication Networks in an Organization; Intra- organizational communication (2)

INTER ORGANIZATIONAL COMMUNICATION : Flow Nomenclature; Workplace diversity and intercultural aspects of communication (2)

COMMUNICATION FUNCTIONS IN ORGANIZATIONS : Teamwork and team dynamics; Conflict resolution strategies and styles; Leading and influencing others-facilitation skills (3)

WRITTEN COMMUNICATION : Email Writing, Professional Reports, and Memos (4)

INTERPERSONAL SKILLS : Nature and Dimensions of Interpersonal Communication; Personality and Communication styles; Active listening and intentional responding; Working with emotional intelligence (4)

Total L: 15

REFERENCES:

1. Bagchi Subroto , "The Professional", Penguin Publications, UK, 2011.
2. PMBOK guide , "A Guide to the Project Management Body of Knowledge", Project Management Institute Inc, USA, 2013.

19GF02 HUMAN VALUES THROUGH LITERATURE

1 0 0 1

PROSE : Kalam's vision of college education in Wings of fire - Emerson's advocacy of independence of Human will in Self-reliance - Harmony in Education-views of Bertrand Russel (4)

POETRY : Maintaining Human relations in Robert Frost's Mending Wall - Quest for identity and freedom in Kamala Das's An Introduction (2)

DRAMA : Statesmanship and friendship in Girish Karnad's Tughlaq (3)

ONE-ACT PLAY : The theme of love in Chekhov's The Bear (3)

SHORT STORY : Empathy in Somerset maugham's Mr. Know-all - Family bond in Anita Desai's Devoted son (3)

Total L: 15

TEXT BOOKS:

1. Faculty - Department of English , "Course materials", PSG College of Technology, Coimbatore, 2019.

REFERENCES:

1. Abrams M .H, Harpham , "A Glossary of Literary Terms", Cengage, Boston, 2015.
2. Scholes R, et.al. , "Elements of Literature", IV, Indian Rpt. OUP, New Delhi, 2013.

HUMANITIES

19OFA1 EXPORT – IMPORT PRACTICES

1 0 0 1

INTRODUCTION : Export – Import Business – Preliminaries for starting Export – Import Business Registration. (3)

EXPORT PROCEDURES : : Obtaining an Export License – Export Credit Insurance – Procedures and Documentation (4)

FOREIGN EXCHANGE : Finance for Exports – Pricing - Understanding Foreign Exchange Rates. (3)

IMPORT PROCEDURES : Import Policy – License - Procedure and Documentation. (3)

EXPORT INCENTIVES : Incentives - Institutional support (2)

Total L: 15

REFERENCES:

1. Ramagopal C , "Export Import Procedures - Documentation and Logistics", New Age International, 2014.
2. Cherian and Parab , "Export Marketing", Himalaya Publishing House, New Delhi, 2008.
3. Parul Gupta , "Export Import Management", MC-Graw Hill, 2017.
4. Justin Paul, Rajiv Aserkar , "Export Import Management", Oxford, 2013.

19OFA2 INSURANCE - CONCEPTS AND PRACTICES

1 0 0 1

INTRODUCTION TO INSURANCE AND RISK MANAGEMENT : Origin, History, Nature and Scope of insurance – Meaning, types

and significance of risk. (3)

INSURANCE LAWS AND REGULATIONS : Insurance Act, IRDA Act, Consumer Protection Act, Ombudsman Scheme. (2)

INSURANCE UNDERWRITING AND RISK MANAGEMENT : Meaning of underwriting and underwriter, guidelines and steps in the process of underwriting – characteristics, significance and principles of risk management. (4)

FINANCIAL ASPECTS OF INSURANCE MANAGEMENT : Role and functions of financial institutions, determination of premium for various insurance products. (3)

SETTLEMENT OF INSURANCE CLAIMS : Documents needed during various claims, Factors affecting insurance claims (3)

Total L: 15

REFERENCES:

1. Scott Harrington, Gregory Niehaus , "Risk Management and Insurance", McGraw Hill Education, 2017.
2. George E Rejda , "Principles of Risk Management & Insurance", Pearson Education, 2017.
3. John Hull , "Risk Management & Financial Institution", John Wiley and Sons, 2018.
4. Arjun Mittal, D D Chaturvedi , "Insurance and Risk Management", Scholar Tech Press, 2017.

190FA3 PUBLIC FINANCE

1 0 0 1

INTRODUCTION: Nature and Scope of public finance – Principles of taxation. (2)

PUBLIC REVENUE AND TAXATION: Sources of Revenue – Tax and non-tax revenue – Classification of Taxes, GST. (4)

PUBLIC EXPENDITURE: Importance – Types – Causes of increase in public expenditure – Effects of public expenditure in India. (3)

DEFICIT FINANCING AND BUDGET: Sources of public debt – Debt redemption – Budget – Types – Preparation of Budget in India. (3)

FEDERAL FINANCE: Centre-State financial relations – Finance commissions. (3)

TOTAL: 15

REFERENCE BOOKS:

1. Richard A Musgrave and Peggy B Musgrave, "Public Finance in Theory and Practice" – Tata McGraw Hill Education, New Delhi, 2004.
2. Bhatia H.L, "Public Finance" – Vikas Publishing House, 29th Edition, New Delhi, 2012.
3. David N Hyman, "Public Finance: A contemporary application of theory and policy", Cengage Publication, 11th Edition, Noida, 2014.
4. Santhosh Dalvi and Krishnan Venkatasubramanian, "An introduction to Goods and Service Tax: The biggest tax reform in India", CCH Publisher, New Delhi, 2015.

190FA4 SECURITY ANALYSIS AND PORTFOLIO MANAGEMENT

1 0 0 1

INVESTMENT ENVIRONMENT : Financial Markets - Classification - Financial Instruments – Security Trading. (2)

TYPES OF SECURITIES : Trading – Orders, Margin Trading – Clearing and Settlement Procedures. (5)

SECURITY ANALYSIS I : Industry Analysis –Estimation of Rates of Return. (2)

SECURITY ANALYSIS II : Company Analysis — Estimation of Rates of Return. (2)

PORTFOLIO MANAGEMENT: Measuring Risk and Returns and Treatment in Portfolio Management. (4)

Total L: 15

REFERENCES:

1. William F Sharpe, Gordon J. Alexander, Jeffery V Bailey , "Investments", Prentice Hall, 2012.
2. Prasanna Chandra , "Investment Analysis and Portfolio Management", TATA McGraw Hill Publishing, 2011.
3. Ranganathan , "Investment Analysis and Portfolio Management", Pearson, 2004.
4. Bhalla V K , "Investment Management", TATA McGraw Hill Publishing, 2011

19OFA5SOCIAL ENTREPRENEURSHIP

1 0 0 1

INTRODUCTION TO SOCIAL ENTREPRENEURSHIP: Social Entrepreneur - Meaning, qualities and skills. Social Entrepreneurship – Characteristics, process and ecosystem – Case Studies. (3)

SOURCES OF FUNDING FOR SOCIAL ENTREPRENEURSHIP: The Social Entrepreneurship Frame work. Start-ups and funding - Internal and External. Schemes for social entrepreneurship. (4)

STRATEGIES IN SOCIAL ENTREPRENEURSHIP: Industry and Market Analysis, Business planning, concepts of value creation, new ideas and risk taking. (4)

PROSPECTS AND PROBLEMS IN SOCIAL ENTREPRENEURSHIP: Opportunities for Social entrepreneurs, an overview of legal structure, tax structure and other liabilities. (4)

TOTAL: 15

REFERENCE BOOKS:

1. S.S.Khanka, "Creativity and Innovation in Entrepreneurship", Sultan Chand & Sons, 2021.
2. C. Paramasivan, "Social Entrepreneurship", New Century Publications, 2016.
3. Robert A. Philips Margret Boniefel Ritesh Sharma, "Social entrepreneurship, the next big business opportunity", Global Vision Publishing House, 2011.
4. Drucker, Peter, "Innovation and Entrepreneurship", Harper Business, 2006.