

**DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY  
LUCKNOW**



**Evaluation Scheme & Syllabus**

**for**

**B.Tech. First Year**

**(Bio-Technology)**

**On**

**Choice Based Credit System**

**(Effective from the Session: 2016-17)**

**B. Tech. in Biotechnology**  
**First Semester**

S. No.	Subject Code	Subject Name	L-T-P	Th/Lab Marks	Sessional		Total	Credit
					Test	Assig/Att.		
1	RBT-103/RBT-102	Elementary Maths-I/ Remedial Biology-I	3-1-0	70	20	10	100	4
2	RAS-101	Engineering Physics-I	3-1-0	70	20	10	100	4
3	REE-101	Basic Electrical Engineering	3-1-0	70	20	10	100	4
4	RAS-104	Professional Communication	3-0-0	70	20	10	100	3
5	REC-101	Basic Electronics	3-1-0	70	20	10	100	4
6	RAS-151	Engineering Physics Lab	0-0-2	50		50	100	1
7	REE-151	Basic Electrical Engineering Lab	0-0-2	50		50	100	1
8	RAS-154	Professional Communication Lab	0-0-2	50		50	100	1
9	RME-151	Workshop Practice	0-0-3	50		50	100	2
	<b>Total</b>						<b>900</b>	<b>24</b>

**B. Tech. in Biotechnology**  
**Second Semester**

S. No.	Subject Code	Subject Name	L-T-P	Th/Lab Marks	Sessional		Total	Credit
					Test	Assig/Att.		
1	RBT-203/RBT-202	Elementary Maths-II/ Remedial Biology-II	3-1-0	70	20	10	100	4
2	RAS-201	Engineering Physics-II	3-1-0	70	20	10	100	4
3	RME-201	Elements of Mechanical Engg.	3-1-0	70	20	10	100	4
4	RCS-201	Computer System & Programming in C	3-0-0	70	20	10	100	3
5	RAS-202	Engineering Chemistry	3-1-0	70	20	10	100	4
6	RAS-252	Engineering Chemistry Lab	0-0-2	50		50	100	1
7	RME-251	Mechanical Engineering Lab	0-0-2	50		50	100	1
8	RCS-251	Computer Progm. Lab	0-0-2	50		50	100	1
9	RCE-251	Computer Aided Engg. Graphics	0-0-3	50		50	100	2
	<b>Total</b>						<b>900</b>	<b>24</b>

# SYLLABUS

**RBT-102**

## **Remedial Biology-I**

<b>L</b>	<b>T</b>	<b>P</b>
<b>3</b>	<b>1</b>	<b>0</b>

### **Unit-I:**

The cell concept, structure of prokaryotic, eukaryotic cells, plant cells and animal cells, Structure and function of cell membrane, cell organelles and their function. Structure and use of compound microscope, Macro and micro molecules, Basic chemical constituents of living body.

### **Unit-II:**

Tissues in animal and plants, Morphology, anatomy and functions of different parts of plants: Root, stem, leaf, inflorescence, flower, fruit and seed, Concepts of botanical garden, herbaria, zoological park and museums.

### **Unit-III:**

Classification of living organisms (Five kingdom classification, major groups and principles of classification in each kingdom), Systematic and binomial system of nomenclature, Concept of animal and plant classification.

### **Unit-IV:**

Concepts of alleles and genes, Mendelian Experiments, Cell cycle (Elementary Idea), mitosis and meiosis, techniques to study mitosis and meiosis.

### **Unit-V:**

Plant Physiology: Concepts of diffusion, osmosis, imbibitions, Movement of water, food, nutrients and gases, Photosynthesis, plant growth and development.

### **Recommended Text Book:**

1. Biology-Textbook of Class XI, NCERT Publication
2. Biology-Textbook of Class XII, NCERT Publication

### **Reference Book:**

Biology by Peter H Raven, George b Johnson, Kenneth A., Mason, Jonathan Losos, Susan Singer (MacGraw Hill Publication)

**Elementary Mathematics-I**

<b>L</b>	<b>T</b>	<b>P</b>
<b>3</b>	<b>1</b>	<b>0</b>

**UNIT-I: ALGEBRA:** Statement of Fundamental Theorem of Algebra, solution of quadratic equations in the complex number system. Linear inequalities. Algebraic solutions of linear inequalities in one variable and their representation on the number line. Graphical solution of linear inequalities in two variables. Solution of system of linear inequalities in two variables-graphically.

**UNIT-II :** Permutations & Combinations: Fundamental principle of counting. Factorial  $n(n!)$ . Permutations and combinations, derivation of formulae and their connections, simple applications. Sequence and Series: Arithmetic progression (A. P.). arithmetic mean (A.M.) Geometric progression (G.P.), general term of a G.P., sum of  $n$  terms of a G.P., geometric mean (G.M.), relation between A.M. and G.M. Sum to  $n$  terms of the special series  $n$ ,  $n^2$  and  $n^3$ .

**UNIT – III : COORDINATE GEOMETRY**

1. Straight Lines: Brief recall of 2D from earlier classes. Slope of a line and angle between two lines. Various forms of equations of a line: parallel to axes, point-slope form, slope-intercept form, two point form, intercepts form and normal form. General equation of a line. Distance of a point from a line.
2. Conic Sections: Sections of a cone: circle, ellipse, parabola, hyperbola, a point, a straight line and pair of intersecting lines as a degenerated case of a conic section. Standard equations and simple properties of parabola, ellipse and hyperbola. Standard equation of a circle.
3. Introduction to Three -dimensional Geometry Coordinate axes and coordinate planes in three dimensions. Coordinates of a point. Distance between two points and section formula.

**UNIT –IV : CALCULUS**

Limits and Derivatives: Derivative introduced as rate of change both as that of distance function and geometrically, intuitive idea of limit. Definition of derivative, relate it to slope of tangent of the curve, derivative of sum, difference, product and quotient of functions. Derivatives of polynomial and trigonometric functions.

**UNIT –V :** Continuity and Differentiability: Continuity and differentiability, derivative of composite functions, chain rule, derivatives of inverse trigonometric functions, derivative of implicit function. Concept of exponential and logarithmic functions and their derivative. Logarithmic differentiation. Derivative of functions expressed in parametric forms. Second order derivatives. Rolle's and Lagrange's Mean Value Theorems (without proof) and their geometric interpretations. Applications of Derivatives: Applications of derivatives: rate of change, increasing/decreasing functions, tangents & normals, approximation, maxima and minima (first derivative test motivated geometrically and second derivative test given as a provable tool). Simple problems (that illustrate basic principles and understanding of the subject as well as real-life situations).

**Recommended Textbooks.**

- 1) Mathematics - Textbook for Class XI, NCERT Publication
- 2) Mathematics Part I - Textbook for Class XII, NCERT Publication
- 3) Mathematics Part II - Textbook for Class XII, NCERT Publication

## Reference books:

- 1) Higher engineering mathematics by B.V.Ramana (Tata Macgraw Hill)
- 2) Advanced modern engineering mathemtics by Glyn james ( pearson education)

## **RAS101**

### **ENGINEERING PHYSICS-I**

#### **Unit – I: Relativistic Mechanics** **08 Hrs.**

Inertial & non-inertial frames, Galilean transformations, Michelson-Morley experiment, Einstein's postulates, Lorentz transformation equations, Length contraction & Time dilation, Relativistic addition of velocities; Variation of mass with velocity, Mass energy equivalence, Concept of rest mass of photon.

#### **Unit – II: Modern Physics** **10 Hrs.**

Black body radiation spectrum, Weins law and Rayleigh-Jeans law, Assumption of quantum theory of radiation, Planck's law. Wave-particle duality, de-Broglie matter waves, Bohr's quantization rule, Phase and Group velocities, Davisson-Germer experiment, Heisenberg uncertainty principle and its applications, Wave function and its significance, Schrödinger's wave equation ( Time dependent and time independent) – particle in one dimensional potential box, Eigen values and Eigen function.

#### **Unit – III: Wave Optics** **10 Hrs.**

**Interference:** Coherent sources, Interference in thin films (parallel and wedge shaped film), Newton's rings and its applications..

**Diffraction:** Single, double and N- Slit Diffraction, Diffraction grating, Grating spectra, dispersive power, Rayleigh's criterion and resolving power of grating.

#### **Unit – IV: Polarization and Laser** **08 Hrs.**

**Polarization:** Phenomena of double refraction, Nicol prism, Production and analysis of plane, circular and elliptical polarized light, Retardation Plate, Optical Activity, Fresnel's theory, Specific rotation.

**Laser:** Spontaneous and stimulated emission of radiation, population inversion, Einstein's Coefficients, Concept of 3 and 4 level Laser, Construction and working of Ruby, He-Ne lasers and laser applications.

#### **Unit – V: Fiber Optics and Holography** **06 Hrs.**

**Fiber Optics:** Fundamental ideas about optical fiber, Propagation mechanism, Acceptance angle and cone, Numerical aperture, Single and Multi Mode Fibers, Dispersion and Attenuation.

**Holography:** Basic Principle of Holography, Construction and reconstruction of Image on hologram and applications of holography.

#### **Reference Books:**

1. Concepts of Modern Physics - Aurthur Beiser (Mc-Graw Hill)
2. Introduction to Special Theory of Relativity- Robert Resnick (Wielly)
3. Optics –Ajoy Ghatak ( Tata McGraw Hill Education Private Ltd. New Delhi)

4. Optics - Brijlal & Subramanian (S. Chand )
- 5 Engineering Physics- C. Mani Naidu(Pearson)
6. Lasers Principles, Types and Applications- K R Nambiar (New Age)
7. Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New

### **RAS-151/RAS-251**

### **ENGINEERING PHYSICS LAB**

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#### List of Experiments

Any ten experiments, at least four from each group.

#### **Group -A**

1. To determine the wavelength of monochromatic light by Newton's ring.
2. To determine the wavelength of monochromatic light with the help of Fresnel's biprism.
3. To determine the focal length of two lenses by nodal slide and locate the position of cardinalpoints.
4. To determine the specific rotation of cane sugar solution using polarimeter.
5. To determine the wavelength of spectral lines using plane transmission grating.
6. To study the polarization of light by simple reflection using laser.
7. Measurement of Wavelength of a laser (He- Ne) light using single slit diffraction.

#### **Group – B**

8. To determine the specific resistance of a given wire using Carey Foster's bridge.
9. To study the variation of magnetic field along the axis of current carrying - Circular coil and then to estimate the radius of the coil.
10. To verify Stefan's Law by electrical method.
11. To calibrate the given ammeter and voltmeter by potentiometer.
12. To study the Hall effect and determine Hall coefficient, carrier density and - mobility of a given semiconductor using Hall effect set up.
13. To determine the energy band gap of a given semiconductor material.
- 14 To determine E.C.E. of copper using Tangent or Helmholtz galvanometer.
15. To draw hysteresis curve of a given sample of ferromagnetic material and from - this to determine magnetic susceptibility and permeability of the given specimen.
16. To determine the ballistic constant of a ballistic galvanometer.
17. To determine the coefficient of viscosity of a liquid.
18. Measurement of fiber attenuation and aperture of fiber.
19. High resistance by leakage method.
20. Magnetic Susceptibility of paramagnetic solution.

Unit	Content	Hours
<b>Unit-1</b>	Molecular orbital theory and its applications to homo-nuclear diatomic molecules. Band theory of solids. Liquid crystals and its applications. Point defects in Solids. Structure and applications of Graphite and Fullerenes. Concepts of nano-materials and its applications	<b>8</b>
<b>Unit-2</b>	Polymers: Basic concepts of polymer- blends and composites. Conducting and biodegradable polymers. Preparations and applications of some industrially important polymers (Buna N, Buna S, Neoprene, Nylon 6, Nylon 6,6, Terylene). General methods of synthesis of organometallic compound (Grignard Reagent) and their applications in polymerization.	<b>8</b>
<b>Unit-3</b>	Electrochemistry: Galvanic cell, electrode potential, Lead storage battery. Corrosion, causes and its prevention. Setting and hardening of cement, applications of cement. Plaster of paris. Lubricants- Classification, mechanism and applications..	<b>8</b>
<b>Unit-4</b>	Hardness of water. Disadvantage of hard water. Boiler troubles, Techniques for water softening; Lime-soda, Zeolite, Ion exchange resin, Reverse osmosis. Phase Rule and its application to water system.	<b>8</b>
<b>Unit-5</b>	Fuels; Classification of fuels. Analysis of Coal. Determination of Calorific values (bomb calorimeter & Dulong's method). Biogas. Elementary ideas and simple applications of UV, Visible, IR and $^1\text{H}$ NMR spectral Techniques.	<b>8</b>

**Textbook**

1. Chemistry for Engineers, by S. Vairam and Suba Ramesh; Wiley India

**Reference Books**

1. Textbook of Engineering Chemistry by Dr. Gopal Krishna Bhatt, Acme Publishers
2. Chemistry (9th ed), by Raymond Chang, Tata McGraw-Hill
3. Chemistry Concepts and Applications by Steven S. Zumdahl; Cengage Learning
4. Engineering Chemistry, Wiley India
5. Engineering Chemistry Author: Abhijit Mallick, Viva Books
6. Text Book of Engineering Chemistry by Harsh Malhotra; Sonali Publications
7. Concise Inorganic Chemistry by J.D. Lee; Wiley India
8. Organic Chemistry (6 ed) by Morrison & Boyd; Pearson Education
9. Physical Chemistry by Gordon M. Barrow; Mc-Graw Hill

10. Organic Chemistry, Volume 1(6 ed)& 2 (5ed) by I. L. Finar; Pearson Education
11. Atkins' Physical Chemistry by Peter Atkins & Julio De Paula; Oxford University Press

**RAS 152/ RAS 252**

## **ENGINEERING CHEMISTRY PRACTICALS**

### **LIST OF EXPERIMENTS**

1. Determination of alkalinity in the given water sample.
2. Determination of temporary and permanent hardness in water sample using EDTA ..
3. Determination of available chlorine in bleaching powder.
4. Determination of chloride content in water sample.
5. Determination of iron content in the given solution by Mohr's method.
6. pH- metric titration.
7. Viscosity of an addition polymer like polyester by viscometer.
8. Determination of iron concentration in sample of water by colorimetric method. The method involves the use of KCN as a chelating agent and the measurements are carried out at 480nm.
9. Element detection and functional group identification in organic compounds.
10. Preparation of Bakelite and Urea formaldehyde resin.

Note: Institute can replace two experiments from the aforesaid experiments as per

## ELECTRONICS ENGINEERING

Unit	Topics	Lectures
I	PN junction diode: <b>Introduction of Semiconductor Materials</b> Semiconductor Diode: Depletion layer, V-I characteristics, ideal and practical, diode resistance, capacitance, Diode Equivalent Circuits, Transition and Diffusion Capacitance, Zener Diodes breakdown mechanism (Zener and avalanche) Diode Application: Series , Parallel and Series, Parallel Diode Configuration, Half and Full Wave rectification, Clippers, Clampers, Zener diode as shunt regulator, Voltage-Multiplier Circuits Special Purpose two terminal Devices :Light-Emitting Diodes, Varactor (Varicap) Diodes, Tunnel Diodes, Liquid-Crystal Displays.	12
II	Bipolar Junction Transistors and Field Effect Transistor:  Bipolar Junction Transistor: Transistor Construction, Operation, Amplification action. Common Base, Common Emitter, Common Collector Configuration DC Biasing BJTs: Operating Point, Fixed-Bias, Emitter Bias, Voltage-Divider Bias Configuration. Collector Feedback, Emitter-Follower Configuration. Bias Stabilization. CE, CB, CC amplifiers and AC analysis of single stage CE amplifier ( $r_e$ Model ). Field Effect Transistor: Construction and Characteristic of JFETs. AC analysis of CS amplifier, MOSFET (Depletion and Enhancement)Type, Transfer Characteristic,	10
III	Operational Amplifiers : Introduction and Block diagram of Op Amp, Ideal & Practical characteristics of Op Amp, Differential amplifier circuits, Practical Op-Amp Circuits (Inverting Amplifier, Non inverting Amplifier, Unity Gain Amplifier, Summing Amplifier, Integrator, Differentiator). <b>OPAMP Parameters: Input offset voltage, Output offset voltage, Input biased current, Input offset current</b> Differential and Common-Mode Operation	6
IV	Electronic Instrumentation and Measurements: Digital Voltmeter : Introduction, RAMP Techniques Digital Multimeters: Introduction Oscilloscope: Introduction, Basic Principle, CRT , Block Diagram of Oscilloscope, Simple CRO, Measurement of voltage, current phase and frequency using CRO, <b>Introduction of Digital Storage Oscilloscope and Comparison of DSO with Analog Oscilloscope.</b>	6
V	Fundamentals of Communication Engineering: Elements of a Communication System, Need of Modulation, Electromagnetic spectrum and typical applications. Basics of Signal Representation and Analysis, <b>Introduction of various analog modulation techniques</b> , Fundamentals of amplitude modulation, Modulation and Demodulation Techniques of AM.	6

**Text Books:**

1. Robert L. Boylestand / Louis Nashelsky "*Electronic Devices and Circuit Theory*", Latest Edition, Pearson Education.
2. H S Kalsi, "Electronic Instrumentation", Latest Edition, TMH Publication,.
3. George Kennedy, "Electronic Communication Systems", Latest Edition, TMH,

**Reference Books:**

1. David A. Bell, "*Electronic Devices and Circuits*", Latest Edition, Oxford University Press.
2. Jacob Millman, C.C. Halkias, Staya brataJit, "*Electronic Devices and Circuits*", Latest Edition , TMH.
3. David A. Bell, Electronic Instrumentation and Measurements, Latest Edition, Oxford University Press India.

# ELEMENTS OF MECHANICAL ENGINEERING

RME101/EME201

LTP: 3-1-0

Units	Topic	Hrs
<b>Unit I</b>	<b>Engineering Materials:</b> Importance of engineering materials, classification, mechanical properties and applications of Ferrous, Nonferrous and composite materials.	<b>4</b>
	<b>Manufacturing Processes:</b> classification of manufacturing process, working principle of sand casting, hot & cold forging, arc & gas welding and sheet metal forming process.	<b>5</b>
	<b>Lathe:</b> Construction and working principle of lathe, operations perform on lathe.	
<b>Unit II</b>	<b>Basic Thermodynamics:</b> Introduction, work and heat Transfer, Zeroth law and First Law of Thermodynamics, perpetual motion machine of first kind	<b>3</b>
	<b>Second Law of Thermodynamics:</b> Kelvin-plank statement, cyclic heat engine, Clausius' statement, refrigerator and heat pump, Carnot cycle, Carnot Theorem and its corollary.	<b>5</b>
	<b>Entropy:</b> Clausius inequality, property of Entropy, Entropy principle and its applications.	
<b>Unit III</b>	<b>Properties of pure substances:</b> p-v, p-T, T-s and h-s diagram, dryness fraction and steam tables.	<b>4</b>
	<b>Steam Formation:</b> Classification of boilers, comparison of fire and water tube boilers, construction and working principle of Lancashire boiler, Babcock and Wilcox boiler, boiler mountings and accessories.	
	<b>Internal Combustion Engines:</b> Classification of I.C. Engines and their parts, working principle and comparison between 2 Stroke and 4 stroke engine , difference between SI and CI engines. P-V diagrams of Otto and Diesel cycles. indicated power, brake power, mean effective pressure, engine efficiencies, and specific fuel consumption.	<b>5</b>
<b>Unit IV</b>	<b>Introduction:</b> Introduction to Engineering mechanics and its classification. Laws of mechanics. Physical quantities –units and dimensions.	<b>1</b>
	<b>Force System:</b> Force, Classification & Representation, Parallelogram Law, Lami's theorem, Principle of Transmissibility of forces. Moment of a force, Couple, Varignon's theorem, Resolution of a force into a force and a couple. Resultant of coplanar force system. Equilibrium of coplanar force system, Free body diagrams, Determination of reactions.	<b>4</b>
	<b>Friction :</b> Theory of Dry friction, Coulomb's laws of friction, Numerical on Equilibrium of bodies on rough horizontal and inclined plane, ladder and Belt friction.	<b>3</b>
<b>Unit V</b>	<b>Structural Analysis:</b> Plane Truss, Difference between truss and frame, Perfect and imperfect truss, Assumptions and Analysis of Plane Truss by Method of joints and Method of section, Zero force members	<b>3</b>

	<b>Centre of Gravity and Centroid:</b> Determination of centroid by integration problems on Centroid of composite areas.	<b>2</b>
	<b>Moment of Inertia:</b> , Perpendicular axis theorem and Parallel axis theorem, Radius of gyration, Moment of inertia by integration and problems on moment of inertia of composites areas.	<b>3</b>

**Reference Books:**

1. Manufacturing engineering and technology By Serope Kalpakjian, Steven R. Schmid, PEARSSON Publications
2. Elements of Workshop Technology by Hajra Choudhary Media Promotor
3. Engineering Thermodynamics by P.K.Nag, Mc Graw Hill Pub.
4. Engineering Thermodynamics by P. Chattopadhyay, OXFORD Publication
5. Internal Combustion Engine by V Ganesan, Mc Graw Hill Pub
6. Engineering Mechanics By S. S. Bhavikatti, K. G. Rajashekarappa New age International
7. Engineering Mechanics by R K Bansal Laxmi Publications
8. Basic Mechanical Engineering by Pravin Kumar PEARSSON Publications

## **ELEMENTS OF MECHANICAL ENGINEERING LAB (RME151/RME251)**

**LTP: 0-0-2**

**Total Hrs: 22**

**Note: Minimum of 5 experiments to be conducted from each module**

**Module 1:**

1. Study and Demonstration of mechanical properties using UTM
2. Study and Demonstration of mechanical properties using Hardness/Impact apparatus
3. Study and Demonstration of Babcock and Wilcox and Lancashire boiler
4. Study and Demonstration of various types of Mounting and Accessories of Boilers.
5. Study and Demonstration double acting steam engine.
6. Study and Demonstration of 2 stroke Diesel and Petrol engine.
7. Study and Demonstration of 4 stroke Diesel and Petrol engine

**Module 2:**

1. To verify the parallelogram, Triangle law and Lami's Theorem.
2. To verify the polygon law of force.
3. To determine the coefficient of friction on inclined surface.
4. To determine the coefficient of friction on belt/rope friction.
5. To determine the efficiency and Mechanical Advantage of Worm & worm-wheel experiment for lifting loads
6. Force Analysis on simple truss and Jib-crane Apparatus.

**COURSE OUTCOMES**

1. Solve and analyze the DC & AC electrical circuits using KVL/KCL and network theorems.
2. Solve and analyze the behavior of AC electrical circuits and resonance.
3. Apply the concepts of measurements in measuring electrical quantities.
4. Solve and analyze the behavior of magnetic circuits and demonstrate the working of single phase transformers, auto-transformer and their applications.
5. Demonstrate the working principles of basic electrical machines including DC as well as AC machines and identify the type of electrical machine used for a particular application.

**DETAILED SYLLABUS**

**Unit-I : Electrical Circuit Analysis:**

Introduction, Circuit Concepts: Concepts of network, Active and passive elements, Voltage and current sources, Concept of linearity and linear network, Unilateral and bilateral elements, Source transformation, Kirchhoff's laws, Loop and nodal methods of analysis, Star-delta transformation,

AC fundamentals: Sinusoidal, square and triangular waveforms – Average and effective values, Form and peak factors, Concept of phasors, phasor representation of sinusoidally varying voltage and current.

**Unit-II: Steady- State Analysis of Single Phase AC Circuits:**

Analysis of series and parallel RLCCircuits, Concept of Resonance in series & parallel circuits, bandwidth and quality factor; Apparent, active & reactive powers, Power factor, Concept of power factor improvement and its improvement (Simple numerical problems)

**Network theorems (AC & DC with independent sources):** Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem (Simple numerical problems)

**Unit-III : Three Phase AC Circuits:**

Three phase system-its necessity and advantages, Star and delta connections, Balanced supply and balanced load, Line and phase voltage/current relations, Three-phase power and its measurement (simple numerical problems).

**Measuring Instruments:** Types of instruments, Construction and working principles of PMMC and moving iron type voltmeters & ammeters, Single phase dynamometer wattmeter, Use of shunts and multipliers (Simple numerical problems on shunts and multipliers)

**Unit-IV: Magnetic Circuit:** Magnetic circuit concepts, analogy between electric & magnetic circuits, B-H curve, Hysteresis and eddy current losses, Magnetic circuit calculations (Series & Parallel).

**Single Phase Transformer:** Principle of operation, Construction, EMF equation, Equivalent circuit, Power losses, Efficiency (Simple numerical problems), Introduction to auto transformer.

**Unit-V: Electrical Machines:**

**DC machines:** Principle & Construction, Types, EMF equation of generator and torque equation of motor, applications of DC motors (simple numerical problems)

**Three Phase Induction Motor:** Principle & Construction, Types, Slip-torque characteristics, Applications (Numerical problems related to slip only)

**Single Phase Induction motor:** Principle of operation and introduction to methods of starting, applications.

**Three Phase Synchronous Machines:** Principle of operation of alternator and synchronous motor and their applications.

**Text Books:**

1. "Basic Electrical Engineering", S N Singh; Prentice Hall International
2. "Basic Electrical Engineering", Kuldeep Sahay, New Age International Publishers
3. "Fundamentals of Electrical Engineering", B Dwivedi, A Tripathi; Wiley India
4. "Principles of Electrical Engineering", V. Del Toro,; Prentice Hall International
5. "Electrical Engineering", J. B. Gupta, Kataria and Sons

**Reference Books:**

1. "Electrical and Electronics Technology", Edward Hughes; Pearson
2. "Engineering Circuit Analysis", W.H. Hayt & J.E. Kimerly; Mc Graw Hill
3. "Basic Electrical Engineering", C L Wadhwa; New Age International
4. "Basic Electrical Engineering", T.K. Nagsarkar, M.S. Shukhija; Oxford University Press

**COURSE OUTCOMES**

At the end of the course, the student should be able

- Conduct experiments illustrating the application of KVL/KCL and network theorems to DC electrical circuits.
- Demonstrate the working of various measuring instruments like ammeter, voltmeter, wattmeter, energy meter etc.
- Conduct experiments illustrating the working of magnetic circuits, single phase transformers and auto-transformers.
- Conduct experiments illustrating the behavior of DC and AC machines and identify the type of electric machine used for a particular application.

**LIST OF EXPERIMENTS**

**Note: A minimum of ten experiments from the following should be performed**

1. Verification of Kirchhoff's laws
2. Verification of Superposition theorem
3. Verification of Thevenin's Theorem and Maximum Power Transfer Theorem.
4. Measurement of power and power factor in a single phase ac series inductive circuit and study improvement of power factor using capacitor
5. Study of phenomenon of resonance in RLC series circuit and obtain resonant frequency.
6. Connection and measurement of power consumption of a fluorescent lamp (tube light).
7. Measurement of power in 3- phase circuit by two wattmeter method and determination of its power factor for star as well as delta connected load.
8. Determination of parameters of ac single phase series RLC circuit
9. To observe the B-H loop of a ferromagnetic material in CRO.
10. Determination of (i) Voltage ratio (ii) polarity and (iii) efficiency by load test of a single phase transformer
11. Determination of efficiency of a dc shunt motor by load test
12. To study running and speed reversal of a three phase induction motor and record speed in both directions.

**RCS101/RCS201**

**Computer System and Programming in C**

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3 0 0

**Unit1:**

(10 Lectures)

**Basics of Computer:** Introduction to digital computer, basic operations of computer, functional components of computer, Classification of computers.

**Introduction to operating system:** [DOS, Windows, Linux and Android] purpose, function, services and types.

**Number system:** Binary, octal and hexadecimal number systems, their mutual conversions, Binary arithmetic.

**Basics of programming:** Approaches to Problem Solving, Concept of algorithm and flow charts, Types of computer languages:- Machine Language, Assembly Language and High Level Language, Concept of Assembler, Compiler, Loader and Linker.

**Unit2:**

(8 Lectures)

Standard I/O in “C”, **Fundamental data types-** Character type, integer, short, long, unsigned, single and double floating point, Storage classes- automatic, register, static and external, Operators and expression using numeric and relational operators, mixed operands, type conversion, logical operators, bit operations, assignment operator, operator precedence and associativity.

**Fundamentals of C programming:** Structure of C program, writing and executing the first C program, Components of C language. Standard I/O in C.

**Unit3:**

(10 Lectures)

**Conditional program execution:** Applying if and switch statements, nesting if and else, use of break and default with switch, program loops and iterations: use of while, do while and for loops, multiple loop variables, use of break and continue statements.

**Functions:** Introduction, types of functions, functions with array, passing values to functions, recursive functions.

**Unit 4:**

(6 Lectures)

**Arrays:** Array notation and representation, manipulating array elements, using multi dimensional arrays. Structure, union, enumerated data types

**Unit 5:**

(8 Lectures)

**Pointers:** Introduction, declaration, applications File handling, standard C preprocessors, defining and calling macros, conditional compilation, passing values to the compiler.

Reference:

1. The C programming by Kernighan Brain W. and Ritchie Dennis M., Pearson Education .
2. Computer Basics and C Programming by V.Rajaraman , PHI Learning Pvt. Limited – 2015.
3. Programming in C by Kochan Stephen G. Pearson Education – 2015.

4. Computer Concepts and Programming in C by D.S. Yadav and Rajeev Khanna, New Age International Publication .
5. Computer Concepts and Programming in C by Vikas Gupta, Wiley India Publication
6. Computer Fundamentals and Programming in C. Reema Thareja, Oxford Publication
7. Computer Concepts and Programming in C, E Balaguruswami, McGraw Hill
8. Computer Science- A Structured Programming Approach Using C, by Behrouz A. Forouzan, Richard F. Gilberg, Thomson, Third Edition , Cengage Learning - 2007.
9. Problem Solving and Program Design in C, by Jeri R. Hanly, Elliot B. Koffman, Pearson Addison-Wesley, 2006.
10. Computer Concepts and Programming by Anami, Angadi and Manvi, PHI Publication
11. Computer Fundamental and C programming by K K Gupta, Acme Learning Publication

## **RCS151/RCS251**

### **Computer Programming Lab**

- 1.WAP that accepts the marks of 5 subjects and finds the sum and percentage marks obtained by the student.
- 2.WAP that calculates the Simple Interest and Compound Interest. The Principal , Amount, Rate of Interest and Time are entered through the keyboard.
- 3.WAP to calculate the area and circumference of a circle.
- 4.WAP that accepts the temperature in Centigrade and converts into Fahrenheit using the formula  $C/5=(F-32)/9$ .
- 5.WAP that swaps values of two variables using a third variable.
- 6.WAP that checks whether the two numbers entered by the user are equal or not.
- 7.WAP to find the greatest of three numbers.
- 8.WAP that finds whether a given number is even or odd.
- 9.WAP that tells whether a given year is a leap year or not.
- 10.WAP that accepts marks of five subjects and finds percentage and prints grades according to the following criteria:  
 Between 90-100%-----Print 'A'  
 80-90%-----Print 'B'  
 60-80%-----Print 'C'  
 Below 60%-----Print 'D'
- 11.WAP that takes two operands and one operator from the user and perform the operation and prints the result by using Switch statement.
- 12.WAP to print the sum of all numbers up to a given number.
- 13.WAP to find the factorial of a given number.
- 14.WAP to print sum of even and odd numbers from 1 to N numbers.
- 15.WAP to print the Fibonacci series.
- 16.WAP to check whether the entered number is prime or not.
- 17.WAP to find the sum of digits of the entered number.
- 18.WAP to find the reverse of a number.
- 19.WAP to print Armstrong numbers from 1 to 100.
- 20.WAP to convert binary number into decimal number and vice versa.

21. WAP that simply takes elements of the array from the user and finds the sum of these elements.
22. WAP that inputs two arrays and saves sum of corresponding elements of these arrays in a third array and prints them.
23. WAP to find the minimum and maximum element of the array.
24. WAP to search an element in a array using Linear Search.
25. WAP to sort the elements of the array in ascending order using Bubble Sort technique.
26. WAP to add and multiply two matrices of order  $n \times n$ .
27. WAP that finds the sum of diagonal elements of a  $m \times n$  matrix.
28. WAP to implement `strlen ()`, `strcat ()`, `strcpy ()` using the concept of Functions.
- 23
29. Define a structure data type `TRAIN_INFO`. The type contains Train No.: integer type Train name: string Departure Time: aggregate type `TIME` Arrival Time : aggregate type `TIME` Start station: string End station : string The structure type Time contains two integer members: hour and minute. Maintain a train timetable and implement the following operations:
  - (i) List all the trains (sorted according to train number) that depart from a particular section.
  - (ii) List all the trains that depart from a particular station at a particular time.
  - (iii) List all the trains that depart from a particular station within the next one hour of a given time.
  - (iv) List all the trains between a pair of start station and end station.
30. WAP to swap two elements using the concept of pointers.
31. WAP to compare the contents of two files and determine whether they are same or not.
32. WAP to check whether a given word exists in a file or not. If yes then find the number of times it occurs.

## Professional Communication

S.No.	Unit	Contents
1	<b>Unit-1 Fundamentals of Communications</b>	Technical Communication: features: Distinction between General And Technical Communication; Language as a tool of communications; Levels of communication: Interpersonal, Organizational, Mass communication; The flow of communication: Downward, Upward, Lateral/Horizontal (Peer group) : Importance of technical communication; Barriers to Communication.
2	<b>Unit-II Written Communication</b>	Words and Phrases: Word formation, Synonyms and Antonyms; Homophones; Select vocabulary of about 500-1000 New words; correct Usage: all Parts of Speech; Modals; Concord; Articles; Infinitives; Transformation of sentences; Requisites f Sentence Construction: Paragraph Development: Techniques and Methods- Inductive, Deductive, Spatial , Linear, Chronological etc.
3	<b>Unit-III Business Communication</b>	Principles, Sales & Credit letters; Claim and Adjustment Letters; Job Application and Resumes. Reports: Types; Significance; Structure, Style & Writing of Reports. Technical Proposal; Parts; Types; Writing of Proposal; Significance; Negotiation skills.
4	<b>Unit-IV Presentation Strategies and Soft Skills.</b>	Nuances and Modes of Delivery; Body Language; Dimensions of Speech: Syllable; Accent; Pitch; Rhythm; Intonation; Paralinguistic features of voice; Interpersonal communication: Definition; Types; Team work; Attitude; Way to improve Attitude Listening Skills : Types; Methods for improving Listening Skills.
5	<b>Unit –V Value- Based Text Readings</b>	Following essays from the prescribed text book with emphasis on Mechanics of writing. (i) Humanistic and Scientific Approaches to Human Activity by Moody E. Prior (ii) The Language of Literature and Science by A. Huxley (iii) Man and Nature by J. Bronowski (iv) Science and Survival by Barry Commoner (v) The Mother of the Sciences by A.J. Bahm.
6	<b>Text Book</b>	1. Improve your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, New Delhi. 2. Technical Communication- Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2007, New Delhi. 3. Functional skills in Language and Literature, by R.P. Singh, Oxford Univ. Press, 2005, New Delhi.
7	<b>Reference Books</b>	1. Communication Skills for Engineers and Scientists, Sangeeta Sharma et.al. PHI Learning Pvt. Ltd, 2011, New Delhi. 2. Business Correspondence and Report Writing by Prof. R.C.,Sharma & Krishna Mohan, Tata McGraw Hill & Co.

		<p>Ltd. , 2001, New Delhi.</p> <ol style="list-style-type: none"><li>3. Word Power Made Easy by Norman Lewis, W.R. Goyal Pub. &amp; Distributors, 2009, Delhi.</li><li>4. Developing Communication skills by Krishna Mohan, Meca Bannerji- Macmillan India Ltd. 1990, Delhi.</li><li>5. Manual of Practical Communication by L.U.B. Pandey: A.I.T.B.S. Publications India Ltd.; Krishan Nagar, 2013, Delhi.</li><li>6. English Grammar and Usage by R.P.Sinha, Oxford University Press, 2005, New Delhi.</li><li>7. Spoken English- A manual of Speech and Phonetics by R.K. Bansal &amp; J.B. Harrison Orient Blackswan, 2013, New Delhi.</li></ol>
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**RAS154/RAS254**

**PROFESSIONAL COMMUNICATION LABORATORY PRACTICALS**

Interactive and Communicative Practical with emphasis on Oral Presentation/Spoken Communication based on International Phonetic Alphabets (I.P.A)

**LIST OF PRACTICALS**

1. Group Discussion: Practical based on Accurate and Current Grammatical Patterns.
2. Conversational skills for Interviews under suitable Professional Communication Lab conditions with emphasis on Kinesics.
3. Communication Skills for Seminars/Conferences/Workshops with emphasis on Paralinguistics / Kinesics.
4. Presentation Skills of Technical Paper/Project Reports/Professional Reports based on proper Stress and Intonation Mechanics.
5. Official /Public Speaking based on Rhythmic Patterns.
6. Theme-Presentation /Key-Note Presentation based on correct argumentation methodologies.
7. Individual Speech Delivery/Conferences with skills to defend Interjections/Quizzes.
8. Argumentative Skills/Role Play Presentation with Stress and Intonation.
9. Comprehensions Skills based on Reading and Listening Practicals on a model Audio-Visual Usage.

**Reference Books**

1. Bansal R.K.& Harrison: Phonetics in English, Orient Longman , New Delhi.
2. Sethi & Dhamija: A Course in Phonetics and Spoken English, Prentice Hall, New Delhi.
3. L.U.B. Pandey & R.P.Singh, A Manual of Practical Communication, A.I.T.B.S. Pub. India Ltd. Krishan Nagar, Delhi.
4. Joans Daniel, English Pronouncing Dictionary, Cambridge Univ. Press.

**1. Carpentry Shop:**

1. Study of tools & operations and carpentry joints. 2. Simple exercise using jack plane. 3. To prepare half-lap corner joint, mortise & tennon joints. 4. Simple exercise on woodworking lathe.

**2. Fitting (Bench Working) Shop:**

1. Study of tools & operations 2. Simple exercises involving fitting work. 3. Make perfect male-female joint. 4. Simple exercises involving drilling/tapping/dieing.

**3. Black Smithy Shop:**

1. Study of tools & operations 2. Simple exercises based on black smithy operations such as upsetting, drawing down, punching, bending, fullering & swaging.

**4. Welding Shop:**

1. Study of tools & operations of Gas welding & Arc welding 2. Simple butt and Lap welded joints. 3. Oxy-acetylene flame cutting.

**5. Sheet-metal Shop:**

1. Study of tools & operations. 2. Making Funnel complete with 'soldering'. 3. Fabrication of tool-box, tray, electric panel box etc.

**6. Machine Shop:**

1. Study of Single point cutting tool, machine tools and operations. 2. Plane turning. 3. Step turning 4. Taper turning. 5. Threading

**7. Foundry Shop:**

1. Study of tools & operations 2. Pattern making. 3. Mould making with the use of a core. 4. Casting

**Introduction**

Drawing Instruments and their uses, BIS conventions, Lettering, Dimensioning line conventions and free hand practicing, AUTO CAD, layout of the software, standard tool bar/menus and description of most commonly used tool bars, navigational tools. Co-ordinate system and reference planes. Definitions of HP, VP, RPP & LPP. Creation of 2D/3D environment. Selection of drawing size and scale. Commands and creation of Lines, Co-ordinate points, axes, poly-lines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints.

2 – Sheets Orthographic Projections Introduction, Definitions - Planes of projection, reference line and conventions employed, Projections of points in all the four quadrants, Projections of straight lines (located in First quadrant/first angle only), True and apparent lengths, True and apparent inclinations to reference planes

2 – Sheets Orthographic Projections of Plane Surfaces (First Angle Projection Only)

Introduction, Definitions–projections of plane surfaces–triangle, square, rectangle, rhombus, pentagon, hexagon and circle, planes in different positions by change of position method only.

1 – Sheet Projections of Solids (First Angle Projection Only) Introduction, Definitions – Projections of right regular tetrahedron, hexahedron (cube), prisms, pyramids, cylinders and cones in different positions.

2-Sheets Sections And Development of Lateral Surfaces of Solids Introduction, Section planes, Sections, Section views, Sectional views, Apparent shapes and True shapes of Sections of right regular prisms, pyramids, cylinders and cones resting with base on HP.

1 – Sheet Isometric Projection (Using Isometric Scale Only)

Introduction, Isometric scale, Isometric projection of simple plane figures, Isometric projection of tetrahedron, hexahedron(cube), right regular prisms, pyramids, cylinders, cones, spheres, cut spheres.

1-Sheet

**Text Books**

1. Engineering Drawing - N.D. Bhatt & V.M. Panchal, 48th edition, 2005-Charotar Publishing House, Gujarat.
2. Computer Aided Engineering Drawing - S. Trymbaka Murthy, -I.K International Publishing House Pvt. Ltd., New Delhi, 3rd revised edition- 2006.

**Reference Books**

1. Engineering Graphics - K.R. Gopalakrishna, 32<sup>nd</sup> edition, 2005- Subash Publishers Bangalore.
  2. Fundamentals of Engineering Drawing with an Introduction to Interactive Computer Graphics for Design and Production-Luzadder Warren J., Duff John M., Eastern Economy Edition, 2005-Prentice-Hall of India Pvt. Ltd., New Delhi.
- Engineering Drawing – M.B. Shah, B.C.Rana, 2<sup>nd</sup> Edition, 2

# SYLLABUS

**RBT-202**

## **Remedial Biology-II**

<b>L</b>	<b>T</b>	<b>P</b>
<b>3</b>	<b>1</b>	<b>0</b>

### **Unit-I:**

Brief history of microbiology, Types of microorganisms, Basic idea of domain bacteria, proteobacteria, non proteobacteria Gram –ve and Gram +ve bacteria, lichens, algae, protozoa, helminthes, viral structures, viral multiplication, Role of microorganisms in the production of industrial chemicals and pharmaceuticals.

### **Unit-II:**

Functional Anatomy of Prokaryotic and Eukaryotic Cells: Size, shape, and arrangement of bacterial cells. Structure and function of cells.

### **Unit-III:**

Catabolic & anabolic reactions: enzymes, energy production and carbohydrate metabolism. Lipid & protein catabolism, Energy production mechanism, metabolic diversity & pathways of energy use. Integration of metabolism.

### **Unit-IV:**

Energy Utilization: Structure of mitochondria, cellular respiration, relationship of carbohydrate metabolism to other compounds, Glycolysis, formation of acetyl co-A, Krebs cycle, Electron Transport System and Oxidative Phosphorylation, ATP, factors affecting respiration.

### **Unit-V:**

Reproductive health and human welfare: Population and birth control, sexually transmitted diseases, infertility, Cancer and AIDS, Basic concepts of immunology, vaccines.

### **Recommended Text Book:**

1. Biology-Textbook of Class XI, NCERT Publication
2. Biology-Textbook of Class XII, NCERT Publication
3. Microbiology- Pelzar, Tata McGraw- Hill Publishing Com. Ltd., 2002
4. An introduction to immunology by C.V. Rao, Narosa publishing house

### **Reference Book:**

Biology by Peter H Raven, George b Johnson, Kenneth A., Mason, Jonathan Losos, Susan Singer (MacGraw Hill Publication)  
General Microbiology: Stainier, Adelberg and Ingraham.

**RBT-203**

## **Elementary Mathematics-II**

<b>L</b>	<b>T</b>	<b>P</b>
<b>3</b>	<b>1</b>	<b>0</b>

**UNIT-I:** Integrals: Integration as inverse process of differentiation. Integration of a variety of functions by substitution, by partial fractions and by parts, only simple integrals of the type to be evaluated. Definite integrals as a limit of a sum, Fundamental Theorem of Calculus (without proof). Basic properties of definite integrals and evaluation of definite integrals. Applications of the Integrals: Applications in finding the area under simple curves, especially lines, areas of circles/parabolas/ellipses (in standard form only), area between the two above said curves (the region should be clearly identifiable).

### **UNIT –II: Differential Equations**

Definition, order and degree, general and particular solutions of a differential equation. Formation of differential equation whose general solution is given. Solution of differential equations by method of separation of variables, homogeneous differential equations of first order and first degree. Solutions of linear differential equation of the type:  $\frac{dy}{dx} + py = q$ , where p and q are functions of x.

**UNIT-III: VECTORS:** Vectors and scalars, magnitude and direction of a vector. Direction cosines/ratios of vectors. Types of vectors (equal, unit, zero, parallel and collinear vectors), position vector of a point, negative of a vector, components of a vector, addition of vectors, multiplication of a vector by a scalar, position vector of a point dividing a line segment in a given ratio. Scalar (dot) product of vectors, projection of a vector on a line. Vector (cross) product of vectors.

### **UNIT-IV: THREE-DIMENSIONAL GEOMETRY**

Three - dimensional Geometry: Direction cosines/ratios of a line joining two points. Cartesian and vector equation of a line, coplanar and skew lines, shortest distance between two lines. Cartesian and vector equation of a plane. Angle between (i) two lines, (ii) two planes. (iii) a line and a plane. Distance of a point from a plane.

### **UNIT –V : PROBABILITY**

Random experiments: outcomes, sample spaces (set representation). Events: occurrence of events, 'not', 'and' and 'or' events, exhaustive events, mutually exclusive events Axiomatic (set theoretic) probability, connections with the theories of earlier classes. Probability of an event, probability of 'not', 'and' & 'or' events. Multiplication theorem on probability. Conditional probability, independent events, total probability, Baye's theorem, Random variable and its probability distribution, mean and variance of haphazard variable. Repeated independent (Bernoulli) trials and Binomial distribution.

Recommended Textbooks.

1) Mathematics - Textbook for Class XI, NCERT Publication

- 2) Mathematics Part I - Textbook for Class XII, NCERT Publication
- 3) Mathematics Part II - Textbook for Class XII, NCERT Publication

Reference books:

- 1) Higher engineering mathematics by B.V.Ramana (Tata Macgraw Hill)
- 2) Advanced modern engineering mathemtics by Glyn james ( pearson education)

## **RAS-201**

### **ENGINEERING PHYSICS- II**

#### **Unit – I: Crystal Structures and X-ray Diffraction 10Hrs.**

Space lattice, basis, Unit cell, Lattice parameter, Seven crystal systems and Fourteen Bravais lattices, Co-ordination number, Atomic radius and Packing factor of different cubic structures, Crystal structure of NaCl and diamond, Lattice planes and Miller Indices, Diffraction of X-rays by crystal, Laue's experiment, Bragg's Law, Bragg's spectrometer. Compton Effect.

#### **Unit – II: Dielectric and Magnetic Properties of Materials 10Hrs.**

**Dielectric Properties:** Dielectric constant and Polarization of dielectric materials, Relation between E, D and P, Types of Polarization (Polarizability). Equation of internal fields in liquid and solid (One- Dimensional), Claussius-Mossotti equation, Frequency dependence of dielectric constant, Dielectric Losses, Important applications of dielectric material, Ferroelectricity, Piezoelectricity.

**Magnetic Properties:** Magnetization, Origin of magnetic moment, Dia, para and ferro magnetism, Langevin's theory for diamagnetic material, Phenomena of hysteresis and its applications.

#### **Unit – III: Electromagnetic Theory 06 Hrs.**

Equation of continuity, Maxwell's Equations (Integral and Differential Forms) and its derivations, Displacement Current, Poynting vector and Poynting theorem, EM - Wave equation and its propagation characteristics in free space, non-conducting and conducting media, energy density of electromagnetic wave, Skin depth.

#### **Unit – IV: Band Theory of Solids 06 Hrs.**

Free electron Theory, Formation of bands in Solids, Classification of solids on band theory, Density of states, Fermi-Dirac distribution, Concept of effective mass, Charge carrier density (electrons and holes), Conductivity of semiconductors, carrier concentrations Fermi energy, Position of Fermi level in intrinsic and in extrinsic semiconductors. Temperature dependence of conductivity in semiconductors.

#### **Unit – V: Physics of some technologically important Materials 08Hrs.**

**Superconductors:** Temperature dependence of resistivity in superconducting materials, Effect of magnetic field (Meissner effect), Temperature dependence of critical field, London equations, Josephson theory, persistent currents, Type I and Type II superconductors, BCS theory (Qualitative), High temperature superconductors and Applications of Super-conductors.

**Nano-Materials:** Basic principle of nanoscience and technology, structure, properties and uses of Fullerene, Carbon nanotubes Single and double walled nanotubes, synthesis of nanotubes, Properties and Applications of nanotubes.

#### **Reference books:**

1. Concept of Modern Physics - by Beiser (Tata Mc-Graw Hill)

2. Solid State Physics - by C. Kittel, 7th edition (Wiley Eastern)
3. Materials Science and Engineering - by V. Raghavan (Prentice- Hall India)
4. Solid State Physics - by S.O. Pillai, 5th edition (New Age International)
5. Introduction to Electrodynamics - by David J. Griffith (PH I)
6. Engineering Physics- C. Mani Naidu(Pearson)
7. Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New Delhi)

**DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY  
LUCKNOW**



**Study & Evaluation Scheme with Syllabus  
for  
B.Tech. Second Year  
Biotechnology  
On  
Choice Based Credit System  
(Effective from the Session: 2017-18)**

**2<sup>nd</sup> Year III-SEMESTER**

S. No.	Subject Code	Subject Name	L-T-P	ESE Marks	Sessional		Total	Credit
					CT	TA		
1.	ROE030 to 039/ RAS303	Science Based Open Elective/ Elementary Mathematics-III	3-1-0	70	20	10	100	4
2.	RVE301/ RAS302	Universal Human Values & Professional Ethics/ Environment & Ecology	3-0-0	70	20	10	100	3
3.	RCE309	Fluid Mechanics for Biotechnology	3-0-0	70	20	10	100	3
4.	RBT301	Analytical Techniques in Biotechnology	3-0-0	70	20	10	100	3
5.	RBT302	Microbiology	3-0-0	70	20	10	100	3
6.	RBT303	Biochemistry	3-1-0	70	20	10	100	4
7.	RCE359	Fluid Mechanics for Biotechnology Lab	0-0-2	50	30	20	100	1
8.	RBT351	Analytical Techniques in Biotechnology Lab	0-0-2	50	30	20	100	1
9.	RBT352	Microbiology Lab	0-0-2	50	30	20	100	1
10.	RBT353	Biochemistry Lab	0-0-2	50	30	20	100	1
11.	RME101*	Elements of Mechanical Engineering*	3-1-0	70	20	10	100*	--
12.	RCE151*	Computer Aided Engineering Graphics*	0-0-3	50	30	20	100*	--
Total							1000	24

CT: Class Test

TA: Teacher Assessment

L/T/P: Lecture/ Tutorial/ Practical

**\*B.Tech. II<sup>nd</sup> year lateral entry students belonging to B.Sc. Stream, shall clear the subjects RCE151/RCE251 and RME101/201 of the first year Engineering Programme along with the second year subjects.**

**Science Based Open Electives:**

- a. ROE030/ROE040 Manufacturing Process
- b. ROE031/ROE041 Introduction to soft computing
- c. ROE032/ROE042 Nano Science
- d. ROE033/ROE043 Laser System and Application
- e. ROE034/ROE044 Space Science
- f. ROE035/ROE045 Polymer Science & Technology
- g. ROE036/ROE046 Nuclear Science
- h. ROE037/ROE047 Material Science
- i. ROE038/ROE048 Discrete Mathematics
- j. ROE039/ROE049 Applied Linear Algebra

**2<sup>nd</sup> Year IV-SEMESTER**

S. No.	Subject Code	Subject Name	L-T-P	ESE Marks	Sessional		Total	Credit
					CT	TA		
1.	RAS403/ ROE040 to 049	Elementary Mathematics-III/ Science Based Open Elective	3-1-0	70	20	10	100	4
2.	RAS402/ RVE401	Environment & Ecology/ Universal Human Values & Professional Ethics	3-0-0	70	20	10	100	3
3.	RCH406	Heat & Mass Transfer	3-0-0	70	20	10	100	3
4.	RBT401	Genetics & Molecular Biology	3-0-0	70	20	10	100	3
5.	RBT402	Immunology	3-0-0	70	20	10	100	3
6.	RBT403	Enzyme Engineering	3-1-0	70	20	10	100	4
7.	RCH454	Heat & Mass Transfer Lab	0-0-2	50	30	20	100	1
8.	RBT451	Genetics & Molecular Biology Lab	0-0-2	50	30	20	100	1
9.	RBT452	Immunology Lab	0-0-2	50	30	20	100	1
10.	RBT453	Enzyme Engineering Lab	0-0-2	50	30	20	100	1
11.	RME201*	Elements of Mechanical Engineering*	3-1-0	70	20	10	100*	--
12.	RCE251*	Computer Aided Engineering Graphics*	0-0-3	50	30	20	100*	--
Total							1000	24

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L/T/P: Lecture/ Tutorial/ Practical

**\*B.Tech. II<sup>nd</sup> year lateral entry students belonging to B.Sc. Stream, shall clear the subjects RCE151/RCE251 and RME101/201 of the first year Engineering Programme along with the second year subjects.**

**Science Based Open Electives:**

- a. ROE030/ROE040 Manufacturing Process
- b. ROE031/ROE041 Introduction to soft computing
- c. ROE032/ROE042 Nano Science
- d. ROE033/ROE043 Laser System and Application
- e. ROE034/ROE044 Space Science
- f. ROE035/ROE045 Polymer Science & Technology
- g. ROE036/ROE046 Nuclear Science
- h. ROE037/ROE047 Material Science
- i. ROE038/ROE048 Discrete Mathematics
- j. ROE039/ROE049 Applied Linear Algebra

## **RAS303/RAS403: ELEMENTARY MATHEMATICS-III**

### **UNIT I**

Data and classification: Data type, Classification and summarization of data. Diagrams and graphs, Measures of central tendency, Measures of dispersion, Moments, Skewness, Kurtosis

### **UNIT II**

Probability and Distributions: Definitions of probability, Additive law of probability, Conditional probability, Multiplicative law of probability, Binomial distribution, Poisson distribution, Normal distribution.

### **UNIT III**

Correlation, Regression and Tests: Correlation, Karl Pearson's coefficient of correlation, Rank Correlation, Lines of regression, Non –Parametric tests Sign Test, Mann Whitene Wilcoxon test.

### **UNIT IV**

Tests of Hypothesis and ANOVA: Hypothesis tests, Student's t-test, Chi-square test, F-test, One way and two way analysis of variance.

### **UNIT V**

Design and Quality control: Principles of experimental design and analysis, completely randomized design, Randomized block design, Latin square design, Statistical quality control, Types of quality control, Control chart for variables, Control chart for attributes.

#### **Text Books:**

1. S.P Gupta, Statistical Methods, Sultan Chand and Sons Publishers.
2. Geogr W. and William G., Statistical Methods, IBH Publication.
3. Ipsen J et al., Introduction to Biostatistics, Harper and Row Publication.
4. BS Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.

#### **Reference Books:**

1. N.TJ Baily, Statistical methods in Biology, English University Press.
2. R. Rangaswami, A text book of Agricultural Statistics, New Age Int. Publication.
3. PSS Sundar Rao, An Introduction to Biostatistics, Prentice Hall.
4. Zar J, Biostatistics, Prentice Hall, London.

## **RCE309: FLUID MECHANICS FOR BIOTECHNOLOGY**

### **UNIT I**

Definitions and Fluid Properties: Viscosity, Newton's Law of viscosity, Kinematic Viscosity, Rheological Diagram, Euler Equation and its application, Derivation of Bernoulli Equation from Euler Equation, Applications of Bernoulli's Theorem, Pascal's Law, Hydrostatic Law.

### **UNIT II**

Measurement of Pressure: Definition of Gauge and Absolute Pressure, Barometer, Various Manometers (Piezometer, U-tube manometer, Single column manometers, U-tube & Inverted U-tube differential manometers) & their industrial applications.

### **UNIT III**

Flow Measuring Equipment: Head Flow Meters, Nozzle Meter, Orifice Meter, Venturi Meter, Area Flow Meters, Rotameter, Pitot Tube & Applications of these equipments.

### **UNIT IV**

Pipe fittings, major and minor losses in pipe flow, Calculation of Pressure Drop in a Pipe, Equivalent Length & 'K' factor, Methods of finding dimensional numbers - methods of governing equations, Method of force ratios and Buckingham's  $\pi$  method, Outline of procedure for Buckingham Pi method, Physical significance of dimensionless numbers.

### **UNIT V**

Pumps: Reciprocating Pumps, working of reciprocating pump, work done by reciprocating pump & its applications. Centrifugal Pumps, Main parts of centrifugal pump, Characteristic Curves of Centrifugal Pumps, NPSH, Advantages and Disadvantages of Centrifugal Pumps, applications of centrifugal pumps.

### **Text Books and Reference Books**

1. Fluid Mechanics & Hydraulic Machines by Dr. RK Bansal.
2. McCabe Smith: Unit Operations in Chemical Engineering, McGraw Hill.
3. Fox, RA & McDonald, AT, "Introduction to Fluid Mechanics", 5th ed: John Wiley (1998).
4. Kumar, DS, "Fluid Mechanics", SK Katria and Sons, Delhi (1998.)
5. Rajput RK, Text book of Fluid Mechanics", S. Chand and Co., New Delhi, (1998).
6. Gupta, Vijay and SK Gupta, "Fluid Mechanics and its Applications", Wiley Eastern, New Delhi.

# **RBT301: ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY**

## **UNIT I**

Light microscopy, Bright & Dark Field microscopy, Fluorescence microscopy, Phase Contrast microscopy, TEM, SEM and Atomic force microscopy.

## **UNIT II**

Principle and Operations of Chromatography, Thin layer chromatography, Ion Exchange Chromatography, High Performance Liquid Chromatography (HPLC), Gas Liquid Chromatography (GLC), Gel Filtration Chromatography, Affinity Chromatography.

## **UNIT III**

Theory of Electrophoresis, Factors affecting the migration of substances, supporting media in electrophoresis, Boundary electrophoresis, Paper electrophoresis, Gel electrophoresis, PAGE, SDS-PAGE, Agarose Electrophoresis of Nucleic Acid, Isoelectric Focusing of Protein Pulse Gel Electrophoresis and Western Blotting.

## **UNIT IV**

General principles of electromagnetic radiation, Types of spectra and their biochemical usefulness; Electromagnetic radiation and spectrum, UV-VIS spectrophotometer, Atomic absorption and Atomic emission spectroscopy, X-Ray spectroscopy, NMR and ESR. Circular dichorism (CD) principles, Basics of IR and X-Ray diffraction analysis.

## **UNIT V**

Theory of centrifugation and sedimentation, use and design of different types of rotors; Types of centrifuges, Preparative and analytical centrifugation; Density gradient centrifugation (zonal and isopycnic), Differential Centrifugation, Application of centrifugation for preparative and analytical purpose.

### **Text Books and Reference Books**

1. Wilson, K, Walker, J., Principles and Techniques of Practical Biochemistry. 5th Ed. - Cambridge University Press,. Cambridge 1999.
2. Biotechniques, Theory & Practice: Second Edition by SVS Rana, Rustogi Publications.
3. Biochemical Methods of Analysis, Saroj Dua And Neera Garg : Narosa Publishing House, New Delhi.
4. Bioanalytical Techniques, M.L. Srivastava, Narosa Publishing House, New Delhi.

## **RBT302: MICROBIOLOGY**

### **UNIT I**

Morphology and Classification of bacteria. Culture media. Isolation and identification of microbes, culture techniques. Preservation of cultures.

### **UNIT II**

Physical and chemical methods for the control of microbes. Enumeration of bacteria. Microbial growth kinetics. Cell cultivation system. Strain improvement.

### **UNIT III**

Biological nitrogen fixation, Biofertilizers, Bacterial Photosynthesis: Photosynthetic structures, types of bacterial photosynthesis, photosynthesis pigments, photosynthetic electron transport system, photophosphorylation, dark phase of photosynthesis; CO<sub>2</sub> utilization.

### **UNIT IV**

Applications of microbiology. Environmental; Microbiology of domestic water and waste water. Microbes in bioremediation. Medical Microbiology: tuberculosis, typhoid, diarrhoea, amoebiasis, Rabies and other applications.

### **UNIT V**

Genetic recombination: basic features of transduction, conjugation and transformation, Genotypic changes: mutations (occurrence of mutations, repair, mutation rate, phenotype and designation of bacterial mutant), Cell organelles, Biology of cancerous cells.

#### **Text books:**

1. Microbiology by Pelczar (W C Brown publication).
2. Genral Microbiology by stainer ( Mac Millan Publication).
3. Microbiology by Pawar and Dagniwala ( Himalaya publishing House).

#### **Reference books:**

1. Microbiology –an introduction by Tortora ( Pierson education Publication).
2. Industrial microbiology by Prescott and Dunn.

# RBT303: BIOCHEMISTRY

## UNIT I

Water - Structure, unusual properties, non-covalent interactions, role in biological processes. Ionization of Water, pH scale, Weak Acids, and Weak Bases. Buffers and buffering mechanism, Henderson Hasselbalch equation. Buffering against pH Changes in Biological Systems: Phosphate buffer, Bicarbonate buffer, Protein buffer, Amino acid Buffer & Hemoglobin Buffer System.

## UNIT II

Carbohydrates – classification, structure and functions of monosaccharides, disaccharides and polysaccharides. Ring structure and mutarotation, stereo isomers and structural isomers. Metabolism – Glycolysis & oxidation of Pyruvate, TCA cycle, Gluconeogenesis, Pentose Phosphate Pathway, Oxidative phosphorylation, Disorder/ diseases of carbohydrate metabolism.

## UNIT III

Fats and lipids – Classification, structure and function: Simple, Compound & Derived lipids, Essential fatty acids. Fatty acid synthesis, origin of acetyl-Co A for fat synthesis, Elongation & desaturation of Fatty Acids. Activation & transport of fatty acid from cytosol to mitochondria for oxidation. Oxidation of saturated & unsaturated fatty acids.  $\beta$ ,  $\alpha$ ,  $\omega$  oxidation. Formation and utilization of ketone bodies. Disorder/ diseases of lipid metabolism.

## UNIT IV

Amino acids and proteins - Classification & structure of amino acids. Essential amino acids. Peptide bond formation, Ramachandran plot, Primary, secondary, tertiary & quaternary structure of proteins. Biosynthesis of amino acids from intermediates of Citric Acid Cycle & other major pathways. Biodegradation of amino acids: Deamination, transamination. Urea Cycle, Glucose-Alanine cycle. Disorder/ diseases of amino acids metabolism.

## UNIT V

Purines and pyrimidines – Structure and properties. Metabolism of Nucleotides: Purines & Pyrimidines synthesis : de Novo & salvage pathway, Conversion of nucleoside monophosphates to nucleoside triphosphates, Formation of deoxyribonucleotides. Catabolism & salvage of Purine and Pyrimidine nucleotides. Disorder of purines and pyrimidines metabolism.

### Text books:

1. Principles of Biochemistry: A.L. Lehninger, Nelson and Cox, McMillan Worth Publishers.
2. Harper's Biochemistry-Rober K. Murray, Daryl K. Grammer, McGraw Hill, Lange. Medical Books. 25th edition.
3. Biochemistry : S.C. Rastogi – Third Edition ; Tata McGraw Hill Education Pvt. Ltd. New Delhi.

### Reference books & web sources:

1. Biochemistry: Stryer, W. H. Freeman
2. Biochemistry: Voet and Voet, John Wiley and Sons, Inc. USA
3. Biochemistry: Zubey, WCB.
4. Biochemistry: Garrett and Grisham, Harcourt.

## **RCE359: FLUID MECHANICS FOR BIOTECHNOLOGY LAB**

1. To determine the local velocity pressure with the help of pilot tube.
2. To determine the viscosity of a given viscous liquid by capillary tube flow method.
3. To differentiate between laminar and turbulent flow using Reynolds experiment.
4. To study the characteristics of an air compressor.
5. To study the characteristics of a centrifugal pump.
6. To determine velocity through orifice meter, venturi meter.
7. Study and verification of the flow pattern in a Bernoulli's apparatus.
8. To determine the minimum fluidization velocity in a fluidized bed and verify experimentally.
9. To find the friction losses in a Straight pipe
10. Study of Pipe fittings and Valves.

## **RBT351: ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY LAB**

1. Precision, accuracy and validity of an experiment. Analysis and presentation of data.
2. Absorption maxima– change in absorbance in potassium permanganate with wavelength.
3. Verification of Beer-Lambert's law-using UV-Vis spectrophotometer.
4. To study the structure & function of basic microscope.
5. To study the paper chromatography for plant pigments
6. To study the thin layer chromatography for Amino acids
7. To study the column chromatography for separates the mix samples.
8. To study the analysis of DNA by agarose gel electrophoresis method.
9. To study the analysis of protein by SDS- PAGE method
10. To study the structure & function of laboratory centrifuge and its principle.
11. To study the separation of compounds using liquid-liquid extraction experiments.
12. To study the separation of biological compounds using various membrane separation techniques like filtration, osmosis, dialysis and reverse osmosis.
13. To carry out Protein precipitation using various techniques.

### **Reference book:**

1. Wilson and Walker, "Principles and Techniques of Practical Biochemistry" 4 Edn., Cambridge Knew pros 1997.
2. Biotechniques: Theory & Practice: Second Edition by SVS Rana, Rustogi Publications.
3. Biochemical Methods of Analysis: Saroj Dua And Neera Garg: Narosa Publishing House, New Delhi.
4. Bioanalytical Techniques : ML Srivastava; Narosa Publishing House, New Delhi.

## **RBT352: MICROBIOLOGY LAB**

1. Preparation of nutrient agar slants, plates and nutrient broth and their sterilization. (Microwave Oven, Heating mantles, Fridge, Heating Oven, Tube racks)
2. Inoculation of agar slants, agar plate and nutrient broth (Incubators, Water bath, Laminar hood, dry heat sterilizer i.e. bead sterilizer)
3. Culture of microorganisms using various techniques. (Shakers i.e. Cooling and Open shaker).
4. Simple and differential staining procedures, endospore staining, flageller staining, cell wallstaining, capsular staining, negative staining. (Moist chambers, spirit lamps, slides, loops & microscopes, haemocytometer)
5. Bacterial colony counting. (Moist chambers, spirit lamps, slides, loops & microscopes, haemocytometer)
6. Observation of different vegetative, capsular and spore forms of bacteria & fungus under various microscopes.
7. Isolation of microbes from soil samples and determination of the number of colony forming units. (U.V. spectrophotometer, Colony counter etc.)
8. Study of growth curve of *E. coli*
9. Microscopy
10. Identification and staining of different types of cells.
11. Measurement of various Cell Organelles.
12. Detection of Mitosis with the help of microscope.

### **Practical Books and References**

1. Lab Manual in microbiology by P Gunasekaran (New Age Int. Pub.).

## **RBT353: BIOCHEMISTRY LAB**

1. Preparation of solutions: 1)percentage solutions, 2) molar solutions, 3) normal solutions
2. Standardization of pH meter, preparation of buffers, emulsions.
3. Spectroscopy: determination of absorption maxima ( $\lambda_{\text{max}}$ ) of a given solution
4. Titration of weak acid-weak base
5. Quantitative estimation of carbohydrates
6. Distinguish reducing and non-reducing sugars
7. Quantitative estimation of proteins
8. Estimation of nucleic acids
9. Isoelectric precipitation
10. Separation of sugars, fatty acids and amino acids by paper chromatography
11. Extraction of lipids from plant material
12. Thin layer chromatography
13. Gel electrophoresis

### **Reference books**

1. Wilson and Walker, "Principles and Techniques of Practical Biochemistry", 4 Edn., Cambridge Knew pros 1997.
2. Plummer DT, "An Introduction to Practical Biochemistry", III Edn., Tata McGraw hill.

# RCH406: HEAT & MASS TRANSFER

## UNIT I

**Conduction and Convection:** Introduction, Conduction: Basic concepts of conduction in solids, liquids and gases, Fourier law of heat conduction. Material properties of importance in heat transfer: Thermal conductivity, Specific heat capacity. General equation of heat conduction in cartesian co-ordinate, heat conduction through plane and composite walls, cylinders and spheres Critical and optimum insulation thickness.. Principles of convection, Newton's law of cooling.

## UNIT II

**Radiation:** Basic laws of heat transfer by radiation, Absorptivity, reflectivity and transmissivity, black, white and grey body, emissive power and emissivity, laws of radiation – Planck, Stefan-Boltzmann, Wien's displacement, Kirchhoff's law. Introduction to Heat Transfer Equipments: Classification of heat exchangers, Double pipe, Shell & tube and Plate type heat exchanger, Evaporators.

## UNIT III

**Diffusion:** Classification of mass transfer operation, choice of separation method, Definition of molecular and eddy diffusion, Ficks first law of diffusion, Concept of N & J Flux, Diffusion coefficient, Dependence of diffusion coefficient on temperature, pressure and composition. Mass Transfer Coefficients: Mass transfer in laminar and turbulent regions, F and k type mass transfer coefficients, Film, Penetration and surface renewal theories.

## UNIT IV

**Drying:** Drying, Different modes of drying operation, Types of batch and continuous dryer Definitions of moisture contents, Rate of batch drying, Time of drying, Continuous drying.

## UNIT V

**Crystallization:** Crystallization, Crystallization equipment, Classification of crystallizers Theories of crystallization, Factors governing nucleation and crystal growth rates, controlled growth of crystal.

### Books Recommended

1. Holman, JP: "Heat Transfer" 9<sup>th</sup> ed. McGraw Hill (1989).
2. Treybal, R "Mass Transfer Operations", 3rd ed. New York: McGraw Hill, (1980).

### Reference Books

1. McCabe Smith, Unit Operations in Chemical Engineering, McGraw Hill
2. Foust AS et.al., "Principles of Unit Operations" John Wiley (1980).

## **RBT401: GENETICS & MOLECULAR BIOLOGY**

### **UNIT I**

Fundamental principles of genetics, gene interaction, multiple alleles, complementation, linkage, recombination and linkage mapping, extra-chromosomal inheritance, chromosomes basis of heredity, Sex determination, sex linked, sex limited and sex, influenced inheritance.

### **UNIT II**

Genome organization: Genome organization in prokaryotes and eukaryotes - special features of eukaryotic gene structure and organization, genome organization in mitochondria and chloroplast, DNA content and C-value paradox. Methods to measure DNA content variation - Various types of DNA sequences (simple sequences, repetitive sequences, nonsense sequences, tandem gene clusters, satellites)

### **UNIT III**

Gene structure, DNA & RNA as a genetic material, packaging of DNA as chromosome, central dogma of molecular biology, DNA replication, DNA repair. Linkage and recombination, crossing over and genetic mapping, gene mapping by two point and three point test crosses, Cell cycle regulation and apoptosis.

### **UNIT IV**

Genetic mutation, micro-deletion, Genetic syndrome, Techniques to detect mutation, Transcription in prokaryotes and eukaryotes, genetic code, reverse transcription, mRNA processing. Role of sigma factor in transcription, role of promoters and enhancers, mechanism and regulation of transcription in prokaryotes and eukaryotes,

### **UNIT V**

DNA replication process in prokaryotes & Eukaryotes, Activity of DNA polymerases and topoisomerases, Reverse transcriptase, Translation in prokaryotes and eukaryotes Basic principles of gene cloning and r-DNA technology, genetic code, properties of genetic code, wobble hypothesis, Molecular chaperones.

#### **Text books:**

1. Genetics a conceptual approach, 2<sup>nd</sup> Edition Benjamin A. Pierc WH freeman and, company, New York.
2. Benjamin Levin – Genes VIII, 8 th ed.

#### **Reference books:**

1. Albert B, Bray Denis et al.: Molecular Biology of The Cell, latest ed.
2. Watson, Hopkins, Roberts et al.: Molecular Biology of the Gene, 4 th ed.
3. Genetics- Strickberger, 2<sup>nd</sup>.
4. Baltimore- Molecular Biology of the Cell.
5. Advance Genetics by G.S. Miglani, Narosa Publishing House.

## **RBT402: IMMUNOLOGY**

### **UNIT I**

Introduction to immunity, Characteristics of innate and adaptive immunity, Humoral and Cell mediated immune response, Hematopoiesis, Cells and Molecules of the immune system, Primary and Secondary lymphoid organs, Inflammation, T & B cell maturation, activation and differentiation.

### **UNIT II**

Characteristics and types of Antigens, Factors affecting the immunogenicity, Haptens and adjuvants, ABO blood group antigens, Epitopes, Characteristics of T&B cell epitopes, Structure, functions and characteristics of different classes of antibodies, Antigenic Determinants on Immunoglobulins.

### **UNIT III**

Antigen and antibody interactions, cross reactivity, precipitation reactions, haemagglutination reactions. serological techniques – ELISA, RIA and western blotting, Production and application of monoclonal antibodies.

### **UNIT IV**

Structure and Function of MHC molecules, Exogenous and Endogenous pathways of antigen processing and presentation, Complement system; Structure, function and application of cytokines, regulation of immune response, immune tolerance.

### **UNIT V**

Immunity against infectious diseases (virus, bacteria and protozoan), Vaccines. Hypersensitivity, Autoimmunity, Immune responses and immune therapies for Cancer and AIDS; Transplantation immunology.

#### **Text books:**

1. Immunology and immunotechnology by Ashim K. Chakravarty (Oxford university Press)
2. Immunology by C. Fatima
3. Immunology by Kuby (Free man publication)

#### **Reference books:**

1. Essentials of immunology by Roitt (Blackwell scientific publication)
2. Immunology by Benacera

# **RBT403: ENZYME ENGINEERING**

## **UNIT I**

Introduction to enzymes: Holoenzyme, apoenzyme, prosthetic group. Interaction between enzyme and substrate- lock and key model, induced fit model. Features of active site, activation energy, enzyme specificity and types. IUB system of classification and nomenclature of enzymes. Kinetics of single substrate reactions; Derivation of Michaelis - Menten equation, turnover number; determination of  $K_m$  and  $V_{max}$  (LB plot, ED plot), Importance of  $K_m$  &  $V_{max}$ ; Numerical related to enzyme kinetics, Multi-Substrate reaction mechanisms.

## **UNIT II**

Factors affecting the velocity of enzyme catalyzed reaction- enzyme concentration, temperature, pH, substrate concentration, inhibitors and activators. Enzyme inhibition: irreversible; reversible (competitive, uncompetitive and non competitive inhibition); Substrate and Product inhibition, Allosteric regulation of enzymes, concerted & sequential model; Deactivation Kinetics.

## **UNIT III**

Extraction of crude enzyme from plant, animal and microbial source; some case study. Purification of enzymes by the help of different methods. Methods of characterization of enzymes; criteria of purity. Unit of enzyme activity - definition and importance. Development of enzyme assays.

## **UNIT IV**

Enzyme Immobilization: Adsorption, Matrix entrapment, Encapsulation, Cross linking, Covalent binding and their examples; Advantages and disadvantages of different immobilization techniques. Structure & stability of immobilized enzymes, kinetic properties of immobilized enzymes- partition effect, diffusion effect. Overview of applications of immobilized enzyme systems.

## **UNIT V**

Enzyme Biosensors: elements of biosensors, three generations of biosensors, Types of biosensors: calorimetric, potentiometric, amperometric, optical and piezoelectric. Design of enzyme electrodes and their applications as biosensors in industry, health care and environment. Design of Immobilized Enzyme Reactors- Stirred tank reactors (STR), Continuous Flow Stirred Tank Reactors (CSTR), Packed- bed reactors (PBR), Fluidized-bed Reactors (FBR); Membrane reactors.

### **Text books:**

1. Fundamentals of enzymology by Nicolas C. price and Lewis Stevens. Oxford University Press
2. Enzymes by Trevor Palmer, East west Press
3. Enzyme Technology by Messing

### **Reference books:**

1. Enzymes: Dixon and Webb. (IRL Press)
2. Enzyme technology by Chaplin and Bucke. Cambridge University Press
3. Biochemical engineering fundamentals, second edition. James E Bailey, David F., Ollis, McGraw Hill Intl. Edition

## **RCH454: HEAT AND MASS TRANSFER LAB**

1. To find out the thermal conductivities of Metal rod.
2. To find the thermal conductivity of Composite cylinder.
3. To find out the thermal conductivity of insulating powder.
4. To find the thermal conductivity of liquid / gases.
5. To determine the overall heat transfer coefficient in Parallel flow heat exchanger
6. To determine the overall heat transfer coefficient in Counter flow heat exchanger
7. To determine the overall heat transfer coefficient in Shell and Tube heat exchanger
8. Any Experiment on natural convection
9. Determination of diffusivity of acetone in air.
10. To determine the drying characteristics of given sample.

## **RBT451: GENETICS & MOLECULAR BIOLOGY LAB**

1. How to calculate genetics and allelic frequencies numeric problem analysis.
2. Isolation of Plasmid DNA
3. Isolation of Plant DNA
4. Estimation of DNA content in the given sample by spectrophotometer
5. Determination of T<sub>m</sub> of DNA.
6. Isolation of bacterial genomic DNA.
7. Purification of DNA through Electrophoresis & visualization under UV transilluminator.
8. Polyacrylamide gel electrophoresis of DNA.
9. PCR amplification of DNA and visualization by gel electrophoresis.
10. Isolation and study of polytene chromosome in *Drosophila*.

## **RBT452: IMMUNOLOGY LAB**

1. To determine the blood group and Rh of given blood sample.
2. To perform single radial immunodiffusion
3. To perform double immunodiffusion
4. To perform rocket immune electrophoresis
5. To perform counter current immune electrophoresis
6. To perform Sand-witch ELISA
7. To perform Indirect ELISA
8. To perform Competitive ELISA
9. To prepare the blood smear and stain with leishman stain
10. To identify the blood cells/ immune cell with the help of leishman stain
11. To perform differential count (DLC) of given sample

## **RBT453: ENZYME ENGINEERING LAB**

1. Production of commercially important enzymes from microbial sources.
2. Isolation of alpha amylase from plant source
3. Determination of enzyme activity and specific activity.
4. Partial purification of isolated enzymes.
5. Method of checking the purity of the enzyme -SDS-PAGE
6. Characterization of enzymes-effect of pH , temperature and inhibitors on enzyme activity etc.
7. Identification of Enzyme by different assay
8. Purification of enzymes by different methods
9. Immobilization of enzymes –Different Techniques such as adsorption, entrapment, encapsulation and cross- linking.
10. Strain improvement techniques- physical, chemical and genetic manipulation methods.
11. Formulation of enzyme stability.
12. Enzyme inhibition

### **Reference books**

1. “An Introduction to Practical Enzyme Engineering”, Tata McGraw-Hill.
2. R. Eienthal and M.J. Dansen, “Enzyme Assays –A Practical Approach”, IRL Press, Oxford University Press, Oxford, 1993
3. <http://www.eng.umd.edu/~nsw/ench485/ench485.htm>

## ROE030/ROE040: MANUFACTURING PROCESS

### UNIT I

#### **Basic Metal and Alloys: Properties and Application**

**Properties of material:** Strength, elasticity, stiffness, malleability, ductility, brittleness and hardness. Elementary ideas of fracture, fatigue, and creep. Testing of materials, destructive and nondestructive testing.

**Ferrous materials:** Carbon steels, its classification based on % carbon as low mild, medium and high carbon steel, its properties and applications. Wrought iron, Cast iron, Alloy steels: stainless steel, tools steel.

**Heat Treatment of Materials:** Elementary introduction to Heat-treatment of carbon steels: annealing, normalizing, quenching and tempering and casehardening.

**Non-Ferrous metal and alloys:** Common uses of various non-ferrous metals and alloys and its composition such as Cu-alloys: Al-alloys such as Duralumin.

### UNIT II

**Metal forming:** Introduction, Cold working and hot working, basic metal forming operations and use of such as: Forging, Rolling, Wire & Tube drawing and Extrusion, product and applications. Press-work, die and punch assembly, cutting and forming, applications.

**Casting:** Introduction, Casting process, Pattern and allowances, Moulding sands and its desirable properties, Mould making techniques, Gating system, Casting defects and remedies, Cupola Furnace, Die-casting and its uses.

### UNIT III

**Machining:** Introduction, Classification of machining processes, Lathe-machine: working principle, parts and operations. Shaper and planer machines: principles, parts and operations. Drilling machine: principle, parts and operations. Milling: Principle, parts and operations. Grinding: principle, parts and operations.

**Welding:** Introduction, classifications, basic principles of welding processes, Arc welding: principle, equipment and operations. Gas welding: working principle, types of flames, Soldering and brazing and its uses, heat affected zone in welds and weld defects.

### UNIT IV

**Manufacturing:** Importance of Materials and Manufacturing towards Technological and Socioeconomic developments, Plant location, plant Layout- its types. Types of Production systems, Production versus Productivity.

**Product quality:** Introduction, definition of quality, improvement of product quality, basic quality tools, flow charts, check sheets, histogram, cause and effect diagram, pareto diagram, control charts, their applications and importance, consequences of bad quality.

### UNIT V

**Non-Metallic Materials:** Common types and uses of Wood, characteristics of wood, applications, Cement, types, composition, Concrete, properties and applications, Ceramics, classifications and applications, Rubber, Plastics and Composite-materials, classifications and applications.

**Miscellaneous Process:** Powder-metallurgy process, working principle and applications, plastic-part manufacturing, processes and applications, Galvanizing and Electroplating, principles, processes and applications.

#### **Text/Reference Books:**

1. Kalpakjian and Schmid, Manufacturing Engineering and Technology, 6 ed., Pearson.
2. Lindberg, Processes & Materials of Manufacture, Prentice Hall India.
3. Kumar & Gupta, Manufacturing Processes, Prentice Hall India.
4. Jain, Production Technology, Khanna Publications.
5. Rao, Manufacturing Processes, McGraw Hill Education.
6. James G Brala. Handbook of Manufacturing Processes, How Products, Components and Materials are Made. Industrial Press, New York, 2006.
7. Bruce J Black. Workshop Processes, Practices and Materials, 4 ed., Elsevier, 2010.

# ROE031/ROE041: INTRODUCTION TO SOFT COMPUTING

## UNIT I

**Neural Networks-1(Introduction & Architecture):** Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory.

## UNIT II

**Neural Networks-II (Back Propagation networks):** Architecture: perceptron model, solution, single layer artificial neural network, multilayer perception model; Back Propagation learning methods, effect of learning rule co-efficient; back propagation algorithm, factors affecting Back Propagation training, applications.

## UNIT III

**Fuzzy Logic-I (Introduction):** Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.

## UNIT IV

**Fuzzy Logic –II (Fuzzy Membership, Rules):** Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications & Defuzzificataions, Fuzzy Controller, Industrial applications.

## UNIT V

**Genetic Algorithm (GA):** Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation, Generational Cycle, applications.

## References:

1. S. Rajsekaran & GA Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications”, Prentice Hall of India.
2. NP Padhy, “Artificial Intelligence and Intelligent Systems”, Oxford University Press.
3. Siman Haykin, “Neural Netowrks”, Prentice Hall of India
4. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, Wiley India.
5. Kumar Satish, “Neural Networks”, Tata Mc Graw Hill
6. Fakhreddin O. Karray, Clarence W. De Silva, “Soft Computing and Intelligent System Design: Theory Tools and applications”, Pearson
7. Tripathy, Anuradha, “SoftComputing: Advances And Applications”, Cengage

## ROE032/ROE042: NANO SCIENCE

### UNIT I

**Introduction:** Definition of Nano-Science and Nano Technology, Applications of Nano-Technology.

**Quantum Theory for Nano Science:** Particle in a box, Potential step: Reflection and tunneling (Quantum leak). Penetration of Barrier, Potential box (Traped particle in 3D: Nanodot).

**Physics of Solid State Structures:** Size dependence of properties, crystal structures, face centered cubic nanoparticles; Tetrahedrally bounded semiconductor structures; lattice vibrations.

**Energy Bands:** Insulators, semiconductor and conductors; Reciprocal space; Energy bands and gaps of semiconductors; effective masses; Fermi Surfaces.

**Localized Particles:** Acceptors and deep traps; mobility; Excitons.

### UNIT II

**Quantum Nanostructure:** Preparation of quantum wells, Wires and Dots, Size and Dimensionality effect, Fermi gas; Potential wells; Partial confinement; Single electron Tunneling, Infrared detectors; Quantum dot laser superconductivity.

**Properties of Individual Nano Particles:** Metal nano clusters; Magic numbers; Theoretical modeling of nanoparticles; geometric structure; electronic structure; Reactivity, Fluctuations, Magnetic clusters; Bulk to nanostructure, semiconducting nanoparticles, Optical Properties, Photofragmentation, Coulombic Explosion. Rare Gas & Molecular clusters; Inert gas clusters; Superfluid clusters; Molecular clusters.

### UNIT III

**Growth Techniques of Nanomaterials:** Litho and Nonlithographic techniques, RF Plasma, Chemical methods, Thermolysis, Pulsed laser method, Self-assembly, E-beam evaporation, Chemical Vapour Deposition, Pulsed Laser Deposition.

### UNIT IV

**Methods of Measuring Properties:** Structure: X-ray Diffraction Technique, Particle size determination, surface structure. Microscopy: Scanning Probe Microscopy (SPM), Atomic Force Microscopy (AFM), Field Ion Microscopy, Scanning Electron Microscopy, Transmission Electron Microscopy(TEM). Spectroscopy: Infra red and Raman Spectroscopy, X-ray Spectroscopy, Magnetic resonance, Optical and Vibrational Spectroscopy, Luminescence.

### UNIT V

**Carbon Nano Materials:** Bucky Ball and Carbon Nano- Tubes: Nano structures of carbon (fullerene), Fabrication, Structure. Electrical, Mechanical and Vibrational properties and applications. Nano Diamond, Boron Nitride Nano-tubes, Single Electron Transistors, Molecular Machine, Nano-Biometrics, Nano Robots.

#### Text/Reference Books:

1. CP Poole Jr, FJ Owens, "Introduction to Nanotechnology".
2. C Kittel, "Introduction to S.S. Physics"-(7<sup>th</sup> Edn.) Wiley 1996.
3. HS Nalwa, "Handbook of Nanostructured Materials & Nanotechnology" vol. 5. Academic Press 2000.

# ROE033/ROE043: LASER SYSTEMS AND APPLICATIONS

## UNIT I

**Basic Principle of Modern Physics:** Black body radiation, Atomic structure, Spectral series of hydrogen atom, Polarization, Absorption and fluorescence of X-ray, Energy distribution in electrons, Probability of distribution of free electrons, Free electron in metals, Energy level in free electrons, Application of Schrodinger equation in potential well, potential step, tunneling effect.

## UNIT II

**Elements and Techniques of Laser:** Concept of coherence, Temporal and Spatial coherence, Coherence length and time, Brightness and Intensity, Directionality and Monochromaticity. Absorption, Spontaneous and Stimulated Emission process and Einstein's coefficients. Population inversion, Pumping and pumping schemes, laser gain, Optical cavities and its types.

## UNIT III

**Principle of Laser & General Lasers:** Main components of Laser, Principle of Laser action, Introduction to general lasers and their types. Three & four level Lasers, Continuous Wave Lasers, Pulsed Lasers, Q-switch lasers.

## UNIT IV

**Types of Laser Systems:**

Solid state Lasers: Neodymium laser, Nd-Yag laser, Nd-Glass laser and Alexandrite laser.

Liquid Lasers: Dye laser, Tuning in Dye laser, Model-Locked Ring Dye laser.

Gas Laser: Ionic lasers, Argon ion laser, Krypton ion laser, He-Cadmium laser, Copper vapour laser, Carbon dioxide laser and Excimers laser.

Semiconductor Laser: Characteristics of semiconductor lasers, Semiconductor diode lasers, Heterojunction lasers, Homojunction lasers, Quantum well lasers.

## UNIT V

**Laser Applications:**

Material Processing: Material processing with lasers, Interaction mechanism, Material processing mechanism, Drilling, Cutting and Welding process with laser. Laser hardening.

Medical Science: Medical lasers, Laser diagnostic, Laser in ophthalmology, laser in glaucoma, Laser for general surgery, Laser in dermatology, laser in dentistry, Laser in medicine.

Optical Communication: Optical source for fiber optical communication, powering and coupling, Transmission, Hologram their characteristics. LIDAR.

**Reference Books:**

1. KR Nambiar, "Laser Principles, Types and Application" New Age International.
2. SA Ahmad, "Laser concepts and Applications" New Age International.
3. AK Katiyar, CK Pandey and Manisha Bajpai, Fundamentals of Laser Systems and Applications.

## ROE034/ROE044: SPACE SCIENCE

### UNIT I

**Introduction:** Important Individual Contributions [Pre Telescopic: Ptolemy, Copernicus, Brahe and Kepler. Post Telescopic Era: Galileo, Newton, Hubble, Gauss, Riemann, Einstein and Hawkins]. Various International Organizations involved in the development of space Science (NASA, ESA, ISRO)

### UNIT II

**Space Observations:** Problems related to Eye and Atmosphere and their Remedies, Distance in Space and Magnitude, Measurement Techniques, Non-Optical Telescopic Techniques used in space observation (Covering entire Electromagnetic Region).

### UNIT III

**Solar System:** Nebular theory of formation of our Solar System. Sun-its origin and fate, Source of Energy and Solar wind. Brief description of Planets about shape, size, period of rotation about axis and period of revolution, distance of planets from sun. Bode's law, Kepler's Laws of planetary motion, Newton's deductions from Kepler's Laws, Newton's Law of gravitation, correction of Kepler's third law. Determination of mass of Earth, Determination of mass of planets with respect to earth. Brief description of Asteroids, Satellites and Comets.

### UNIT IV

**Stars and Galaxy:** Stellar Evaluation and Stellar Remnants, Nucleo-Synthesis and Formation of Elements. Classification of Stars: Harvard classification system, Hertzsprung-Russel Diagram, Luminosity of star, variable stars; composite stars (white dwarfs, Neutron stars, black hole, star clusters, supernova and binary stars); Chandrasekhar limit. Galaxies: Galaxies and their evolution and origin, active galaxies and quasars.

### UNIT V

**Cosmology:** Hubble Law, Redshift and Expansion of the Universe, Cosmic Microwave, Background Radiations, Matter density in Universe, Cosmological principle, Important Models of Universe (Steady State and Big Bang), Dark Matter and Dark Energy.

#### **Text Books / Reference Books:**

1. Baidyanath Basu, T. Chattopadhyay, SN Biswas, "An Introduction to Astrophysics" PHI 2<sup>nd</sup> Edition.
2. KS Krishnaswami, "Astrophysics: A modern Perspective" New Age International.

## **ROE035/ROE045: POLYMER SCIENCE AND TECHNOLOGY**

### **UNIT I**

Basic Concepts of Polymers: A brief history. what are polymers? how are polymers made? Classification of polymers.

### **UNIT II**

Chemistry of Polymerization: Introduction, Chain polymerization, step growth polymerization, Miscellaneous polymerization reactions. Polymerization Techniques.

### **UNIT III**

Molecular weight and Size: Average molecular weight, Number average and weight average molecular weight. Sedimentation and viscosity-average molecular weight. Molecular weight and degree of polymerization. Polydispersity and molecular weight distribution in polymers. Practical significance of polymer molecular weight. Size of polymer molecules.

### **UNIT IV**

Polymer Degradation: What is polymer degradation? Types of degradation, thermal and mechanical degradation, degradation by ultrasonic waves. photo degradation, degradation by high energy radiation, oxidative degradation, hydrolytic degradation.

### **UNIT V**

Preparations and Applications: Preparation, properties and technical applications of thermoplastics, thermosetting, elastomer and synthetic fibres. Silicones. Applications of polymers in aerospace, ocean, electronics, medical, agriculture, automobile, sports and building constructions.

## ROE036/ROE046: NUCLEAR SCIENCE

### UNIT I

**Nucleus and Its Basic Features:** Nuclear structure, Nuclear forces and their properties, Nuclear binding energy, Nuclear stability, Nuclear radius and its measurement, Nuclear spin, Nuclear magnetic and Electrical moments.

### UNIT II

**Nuclear Models:** Single particle model, Liquid drop model and Semi-Emperical mass formula, Nuclear potential and Shell model, Collective model.

### UNIT III

**Nuclear Reaction:** Nuclear reaction and Laws of conservation, Types of nuclear reaction, Mechanism of nuclear reaction-Q value, Nuclear fission and their explanation by liquid drop model, Nuclear fusion and its applications.

### UNIT IV

**Radioactivity:** Radioactive disintegration, Decay constant, Half life period and Mean life, Alpha decay, Beta decay, Gamma decay, Interaction of nuclear radiation with matter.

### UNIT V

**Accelerators:** Mass spectrograph: General principle, Aston's Mass Spectrograph Van de Graph Generator, Cyclotron, Synchrotron.

**Detectors:** G M Counter, Scintillation counter, cloud chamber, Bubble Chamber, production and detection of neutrons and Gamma-photon.

**Application of Nuclear Techniques:** Nuclear magnetic resonance, positron emission topography, radiotracer techniques and applications in material science and agriculture.

### Reference Books:

1. Tayal, "Nuclear Physics" Himalaya Publishing House.
2. SN Ghosal, "Nuclear Physics" S. Chand & Co.
3. SB Patel, "Nuclear Physics: An Introduction New Age International.
4. HB Lal, "Introductory Nuclear Physics" United Book Depot.
5. Wang, "Introductory Nuclear Physics", PHI Learning
6. Roy & Nigam, "Nuclear Physics" John Wiley & sons.

## ROE037/ROE047: MATERIAL SCIENCE

### UNIT I

**Introduction:** Historical perspective, importance of materials, Brief review of modern & atomic concepts in Physics and Chemistry. Atomic models, Periodic table, Chemical bonding.

**Crystallography and imperfections:** Concept of unit cell, space lattice, Bravais lattices, common crystal structures, Atomic packing factor and density. Miller indices. X-ray crystallography techniques, imperfections, Defects & Dislocations in solids.

### UNIT II

**Mechanical Properties and Testing:** Stress strain diagram, Ductile and brittle materials, stress Vs strength, toughness, hardness, fracture, fatigue and creep. Testing, such as Strength testing, Hardness testing, Impact testing, Fatigue testing Creep testing, Non-destructive testing (NDT)

**Micro Structural Exam:** Microscope principle and methods, Preparation of samples and micro structure exam and grain size determination, comparative study of microstructure of various metals and alloys, such as Mild steel, CI, Brass.

**Phase Diagram and Equilibrium Diagram:** Unitary and Binary diagrams, Phase rules, Types of equilibrium diagrams: solid solution type, eutectic type and combination type, Iron-carbon equilibrium diagram.

### UNIT III

**Ferrous materials:** Iron and steel manufacture, furnaces, various types of carbon steels, alloy steels and cast irons, its properties and uses.

**Heat Treatment:** various types of heat treatment, such as Annealing, Normalizing, Quenching, Tempering and Case hardening. Time Temperature Transformation (TTT) diagrams.

**Non-Ferrous metals and alloys:** Non-ferrous metals, such as Cu, Al, Zn, Cr, Ni etc. and its applications. Various types of Brass, Bronze bearing materials their properties and uses. Aluminum alloys, such as Duralumin, Other advanced materials/alloys.

### UNIT IV

**Magnetic properties:** Concept of magnetism-Dia, para, ferro magnetic materials, Hysteresis, Soft and hard magnetic materials, Magnetic Storages.

**Electric Properties:** Energy band, concept of conductor, insulator and semi conductor. Intrinsic and extrinsic semi-conductors, P-n junction and transistors, Basic devices and their applications. diffusion of Solid. Super conductivity and its applications, Messier effect. Type I & II superconductors. High Temp. superconductors.

### UNIT V

**Ceramics:** Structure, types, properties and applications of ceramics. Mechanical/Electrical behavior and processing of ceramics.

**Plastics:** Various types of polymers/plastics and their applications. Mechanical behavior and processing of plastics, Future of plastics.

**Other Materials:** Brief description of other materials, such as optical and thermal materials, concrete, composite materials and their uses.

**Performance of materials in service:** Brief theoretical consideration of fracture, fatigue, and corrosion and its control.

#### Text/ Reference Books:

1. WD Callister Jr. "Material Science & Engineering Addition", Wesley Publishing Co.
2. Van Vlash, "Elements of Material Science & Engineering", John Wiley & Sons.
3. V. Raghvan, "Material Science", Prentice Hall of India.
4. Narula, "Material Science", Tata Mc Graw Hill.
5. Srivastava, Srinivasan, "Science of Materials Engineering", New Age International.

# ROE038/ROE048: DISCRETE MATHEMATICS

## UNIT I

Relation: Definition, types of relation, composition of relations, pictorial representation of relation, properties of relation, partial order relation.

Function: Definition and types of functions, composition of functions, recursively defined functions.

Group: Monoid, Semi-group, Abelian Group, Properties of groups, Cyclic Group, Permutation groups, Cayley's Theorem, Rings and Fields (definition, examples and standard results).

## UNIT II

Propositional logic: Introduction to logic, logical connectives, truth tables, Tautologies, contradiction, normal forms (conjunctive and disjunctive), modus ponens and modus tollens, validity, predicate logic, universal and existential quantification.

Notion of proofs: proof by implication, converse, inverse, contrapositive, negation, and contradiction, direct proof, proof by using truth table, proof by counter example.

## UNIT III

Combinatorics: Mathematical induction, recursive mathematical definitions, basics of counting, Cardinality and Countability, Pigeonhole principle, permutations, combinations, inclusion-exclusion.

## UNIT IV

Recurrence relations ( $n$  th order recurrence relation with constant coefficients, Homogeneous recurrence relations, Inhomogeneous recurrence relation), generating function, properties of generating functions (G.F.), Solution of recurrence relation using G.F, solution of combinatorial problem using G.F.

## UNIT V

Graphs: Graph terminology, types of graph, connected graphs, components of graph, Euler graph, Hamiltonian path and circuits, Graph coloring, Chromatic number.

Tree: Definition, types of tree (rooted, binary), properties of trees, binary search tree, tree traversing (preorder, inorder, postorder).

### Text/Reference Books:

1. Kenneth H. Rosen, "Discrete Mathematics and its Applications", Mc.Graw Hill, 2002.
2. J.P. Tremblay & R. Manohar, "Discrete Mathematical Structure with Applications to Computer Science", Mc.Graw Hill, 1975.
3. V. Krishnamurthy, "Combinatorics: Theory and Applications", East-West Press.
4. Seymour Lipschutz, M. Lipson, "Discrete Mathemataics", Tata McGraw Hill, 2005.
5. Kolman, Busby Ross, "Discrete Matheamatical Structures", Prentice Hall International.

## **ROE039/ROE049: APPLIED LINEAR ALGEBRA**

### **UNIT I**

Fields, Vector-spaces, sub-spaces, linear-combination, linear-dependence and independence. Basis and dimensions (each and every fact to be illustrated by suitable examples).

### **UNIT II**

Linear-transformation, definition and examples, matrix representation, similarity, range and kernel, rank-nullity theorem and its consequences.

### **UNIT III**

Singular and non-singular linear transformations, sum and product of linear transformations, vector space of linear transformations, nilpotent linear transformations.

### **UNIT IV**

Inner product spaces, definition and examples, orthogonality, Cauchy-Schwartz Inequality, Minkowski Inequality, polarization Identity, complete orthonormal set, Bessel's Inequality, Gram-Schmidt's orthogonalization process.

### **UNIT V**

Linear functional, definition and examples, vector space of linear functional, dual vector spaces, adjoint, self adjoint, unitary and normal operators, examples and properties, eigen values and eigen vectors, diagonalisation of linear operators, quadratic forms, principle axis theorem (without proof), some applications to engineering problems.

### **Text/Reference Books:**

1. Dym, H., Linear Algebra in action, University Press, 2012
2. Halmos, PR, Finite Dimensional Vector Spaces (1990), Narosa.
3. Hoffman, K. and Kunze, R., Linear Algebra, PHI (2012)
4. Kolman, B. and Hill, DR, Introductory linear algebra with applications (2008), Pearson
5. Lipschutz, S. and Lipson M., Linear Algebra (2005), Schaum's Series.
6. Noble, B. And Daniel, JW, Applied linear algebra (1988), PHI

**A Foundation course  
In  
Universal Human Values and Professional Ethics**

**Universal Human Values and Professional Ethics**

**[L-T-P: 3-0-0]**

**Course Objectives**

This introductory course input is intended

1. To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature

Thus, this course is intended to provide a much needed orientational input in value education to the young enquiring minds.

**Course Methodology**

1. The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.
2. It is free from any dogma or value prescriptions.
3. It is a process of self-investigation and self-exploration, and not of giving sermons. Whatever is found as truth or reality is stated as a proposal and the students are facilitated to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation.
4. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student leading to continuous self-evolution.
5. This self-exploration also enables them to critically evaluate their pre-conditionings and present beliefs.

## **Course Syllabus: Universal Human Values and Professional Ethics [L-T-P: 3-0-0]**

The whole course is divided into 5 modules.

After every two lectures of one hour each, there is a 2 hour practice session.

The teachers are oriented to the inputs through an eight to ten day workshop (Teachers' Orientation Program).

The Teacher's Manual provides them the lecture outline. The outline has also been elaborated into presentations and provided in a DVD with this book to facilitate sharing.

The teacher is expected to present the issues to be discussed as propositions and encourage the students to have a dialogue. The process of dialogue is enriching for both, the teacher as well as the students.

The syllabus for the lectures is given below:

### **UNIT 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education**

1. Understanding the need, basic guidelines, content and process for Value Education
2. Self Exploration—what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfill the above human aspirations: understanding and living in **harmony** at various levels

## **UNIT 2: Understanding Harmony in the Human Being - Harmony in Myself!**

7. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
8. Understanding the needs of Self ('I') and 'Body' - *Sukh* and *Suvidha*
9. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
10. Understanding the characteristics and activities of 'I' and harmony in 'I'
11. Understanding the harmony of I with the Body: *Sanyam* and *Swasthya*; correct appraisal of Physical needs, meaning of Prosperity in detail
12. Programs to ensure *Sanyam* and *Swasthya*
  - Practice Exercises and Case Studies will be taken up in Practice Sessions.

## **UNIT 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship**

13. *Understanding Harmony in the family – the basic unit of human interaction*
14. Understanding values in human-human relationship; meaning of *Nyaya* and program for its fulfillment to ensure *Ubhay-tripti*;  
Trust (*Vishwas*) and Respect (*Samman*) as the foundational values of relationship
15. Understanding the meaning of *Vishwas*; Difference between intention and competence
16. Understanding the meaning of *Samman*, Difference between respect and differentiation; the other salient values in relationship
17. Understanding the harmony in the society (society being an extension of family): *Samadhan*, *Samridhi*, *Abhay*, *Sah-astitva* as comprehensive Human Goals
18. Visualizing a universal harmonious order in society- Undivided Society (*Akhand Samaj*), Universal Order (*Sarvabhaum Vyawastha* )- from family to world family!
  - Practice Exercises and Case Studies will be taken up in Practice Sessions.

## **UNIT 4: Understanding Harmony in the Nature and Existence - Whole existence as Co-existence**

19. Understanding the harmony in the Nature
20. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature
21. Understanding Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all-pervasive space
22. Holistic perception of harmony at all levels of existence
  - Practice Exercises and Case Studies will be taken up in Practice Sessions.

## **UNIT 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics**

23. Natural acceptance of human values
24. Definitiveness of Ethical Human Conduct
25. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
26. Competence in professional ethics:
  - a) Ability to utilize the professional competence for augmenting universal human order
  - b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems,
  - c) Ability to identify and develop appropriate technologies and management patterns for above production systems.
27. Case studies of typical holistic technologies, management models and production systems
28. Strategy for transition from the present state to Universal Human Order:
  - a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers
  - b) At the level of society: as mutually enriching institutions and organizations

### **Guidelines and Content for Practice Sessions**

#### **UNIT 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education**

**PS 1:** Introduce yourself in detail. What are the goals in your life? How do you set your goals in your life? How do you differentiate between right and wrong? What have been your achievements and shortcomings in your life? Observe and analyze them.

**Expected outcome:** the students start exploring themselves; get comfortable to each other and to the teacher and start finding the need and relevance for the course.

**PS 2:** Now-a-days, there is a lot of voice about many techno-genic maladies such as energy and natural resource depletion, environmental pollution, global warming, ozone depletion, deforestation, soil degradation, etc. – all these seem to be man-made problems threatening the survival of life on Earth – What is the root cause of these maladies & what is the way out in your opinion?

On the other hand, there is rapidly growing danger because of nuclear proliferation, arms race, terrorism, criminalization of politics, large scale corruption, scams, breakdown of relationships, generation gap, depression & suicidal attempts, etc – what do you think, is the root cause of these threats to human happiness and peace – what could be the way out in your opinion?

**Expected outcome:** the students start finding that technical education without study of human values can generate more problems than solutions. They also start feeling that lack of understanding of human values is the root cause of all problems and the sustained

solution could emerge only through understanding of human values and value based living. Any solution brought out through fear, temptation or dogma will not be sustainable.

**PS 3:**

1. Observe that each one of us has Natural Acceptance, based on which one can verify right or not right for him. Verify this in case of

- i) What is Naturally Acceptable to you in relationship- Feeling of respect or disrespect?
- ii) What is Naturally Acceptable to you – to nurture or to exploit others?

Is your living the same as your natural acceptance or different?

2. Out of the three basic requirements for fulfillment of your aspirations- right understanding, relationship and physical facilities, observe how the problems in your family are related to each. Also observe how much time & effort you devote for each in your daily routine.

**Expected outcome:**

- 1. The students are able to see that verification on the basis of natural acceptance and experiential validation through living is the only way to verify right or wrong, and referring to any external source like text or instrument or any other person cannot enable them to verify with authenticity; it will only develop assumptions.
- 2. The students are able to see that their practice in living is not in harmony with their natural acceptance most of the time, and all they need to do is to refer to their natural acceptance to remove this disharmony.
- 3. The students are able to see that lack of right understanding leading to lack of relationship is the major cause of problems in their family and not the lack of physical facilities in most of the cases, while they have given higher priority to earning of physical facilities in their life ignoring relationships and not being aware that right understanding is the most important requirement for any human being.

**UNIT 2: Understanding Harmony in the Human Being - Harmony in Myself!**

**PS 4:** List down all your desires. Observe whether the desire is related to Self (I) or Body. If it appears to be related to both, see which part of it is related to Self (I) and which part is related to Body.

**Expected outcome:** the students are able to see that they can enlist their desires and the desires are not vague. Also they are able to relate their desires to 'I' and 'Body' distinctly. If any desire appears related to both, they are able to see that the feeling is related to I while the physical facility is related to the body. They are also able to see that 'I' and 'Body' are two realities, and most of their desires are related to 'I' and not body, while their efforts are mostly centered on the fulfillment of the needs of the body assuming that it will meet the needs of 'I' too.

**PS 5:**

- 1. a. Observe that any physical facility you use, follows the given sequence with time :  
Necessary & tasteful → unnecessary & tasteful → unnecessary & tasteless → intolerable
- b. In contrast, observe that any feeling in you is either naturally acceptable or not acceptable at all. If naturally acceptable, you want it continuously and if not acceptable, you do not want it any moment!

2. List down all your activities. Observe whether the activity is of 'I' or of Body or with the participation of both 'I' and Body.
3. Observe the activities within 'I'. Identify the object of your attention for different moments (over a period of say 5 to 10 minutes) and draw a line diagram connecting these points. Try to observe the link between any two nodes.

**Expected outcome:**

1. The students are able to see that all physical facilities they use are required for a limited time in a limited quantity. Also they are able to see that in case of feelings, they want continuity of the naturally acceptable feelings and they do not want feelings which are not naturally acceptable even for a single moment.
2. the students are able to see that activities like understanding, desire, thought and selection are the activities of 'I' only, the activities like breathing, palpitation of different parts of the body are fully the activities of the body with the acceptance of 'I' while the activities they do with their sense organs like hearing through ears, seeing through eyes, sensing through touch, tasting through tongue and smelling through nose or the activities they do with their work organs like hands, legs etc. are such activities that require the participation of both 'I' and body.
3. The students become aware of their activities of 'I' and start finding their focus of attention at different moments. Also they are able to see that most of their desires are coming from outside (through preconditioning or sensation) and are not based on their natural acceptance.

**PS 6:**

1. Chalk out programs to ensure that you are responsible to your body- for the nurturing, protection and right utilisation of the body.
2. Find out the plants and shrubs growing in and around your campus. Find out their use for curing different diseases.

**Expected outcome:** The students are able to list down activities related to proper upkeep of the body and practice them in their daily routine. They are also able to appreciate the plants wildly growing in and around the campus which can be beneficial in curing different diseases.

**UNIT 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship**

**PS 7:** Form small groups in the class and in that group initiate dialogue and ask the eight questions related to trust. The eight questions are :

- |  |   |
|--|---|
| 1a. Do I want to make myself happy?        | 1b. Am I able to make myself always happy?      |
| 2a. Do I want to make the other happy?     | 2b. Am I able to make the other always happy?   |
| 3a. Does the other want to make him happy? | 3b. Is the other able to make him always happy? |
| 4a. Does the other want to make me happy?  | 4b. Is the other able to make me always happy?  |

*What is the answer?*  
Intention (Natural Acceptance)

*What is the answer?*  
Competence

Let each student answer the questions for himself and everyone else. Discuss the difference between intention and competence. Observe whether you evaluate your intention & competence as well as the others' intention & competence.

**Expected outcome:** The students are able to see that the first four questions are related to our Natural Acceptance i.e. Intention and the next four to our Competence. They are able to note that the intention is always correct, only competence is lacking! We generally evaluate ourselves on the basis of our intention and others on the basis of their competence! We seldom look at our competence and others' intention as a result we conclude that I am a good person and other is a bad person.

**PS 8:**

1. Observe on how many occasions you are respecting your related ones (by doing the right evaluation) and on how many occasions you are disrespecting by way of under-evaluation, over-evaluation or otherwise evaluation.
2. Also observe whether your feeling of respect is based on treating the other as yourself or on differentiations based on body, physical facilities or beliefs.

**Expected outcome:** The students are able to see that respect is right evaluation, and only right evaluation leads to fulfillment in relationship. Many present problems in the society are an outcome of differentiation (lack of understanding of respect), like gender biasness, generation gap, caste conflicts, class struggle, dominations through power play, communal violence, clash of isms, and so on so forth. All these problems can be solved by realizing that the other is like me as he has the same natural acceptance, potential and program to ensure a happy and prosperous life for him and for others though he may have different body, physical facilities or beliefs.

**PS 9:**

1. Write a note in the form of story, poem, skit, essay, narration, dialogue to educate a child. Evaluate it in a group.
2. Develop three chapters to introduce 'social science- its need, scope and content' in the primary education of children

**Expected outcome:** The students are able to use their creativity for educating children. The students are able to see that they can play a role in providing value education for children. They are able to put in simple words the issues that are essential to understand for children and comprehensible to them. The students are able to develop an outline of holistic model for social science and compare it with the existing model.

**Module 4: Understanding Harmony in the Nature and Existence - Whole existence as Co-existence**

**PS 10:** List down units (things) around you. Classify them in four orders. Observe and explain the mutual fulfillment of each unit with other orders.

**Expected outcome:** The students are able to differentiate between the characteristics and activities of different orders and study the mutual fulfillment among them. They are also able to see that human beings are not fulfilling to other orders today and need to take appropriate steps to ensure right participation (in terms of nurturing, protection and right utilization) in the nature.

**PS 11:**

1. Make a chart for the whole existence. List down different courses of studies and relate them to different units or levels in the existence.
2. Choose any one subject being taught today. Evaluate it and suggest suitable modifications to make it appropriate and holistic.

**Expected outcome:** The students feel confident that they can understand the whole existence; nothing is a mystery in this existence. They are also able to see the interconnectedness in the nature, and point out how different courses of study relate to the different units and levels. Also they are able to make out how these courses can be made appropriate and holistic.

**UNIT 5: Implications of the above Holistic Understanding of Harmony at all Levels of Existence**

**PS 12:** Choose any two current problems of different kind in the society and suggest how they can be solved on the basis of natural acceptance of human values. Suggest steps you will take in present conditions.

**Expected outcome:** The students are able to present sustainable solutions to the problems in society and nature. They are also able to see that these solutions are practicable and draw roadmaps to achieve them.

**PS 13:**

1. Suggest ways in which you can use your knowledge of Technology/Engineering/Management for universal human order, from your family to the world family.
2. Suggest one format of humanistic constitution at the level of nation from your side.

**Expected outcome:** The students are able to grasp the right utilization of their knowledge in their streams of Technology/Engineering/ Management to ensure mutually enriching and recyclable productions systems.

**PS 14:** The course is going to be over now. Evaluate your state before and after the course in terms of

- a. Thought    b. Behavior and    c. Work    d. Realization

Do you have any plan to participate in the transition of the society after graduating from the institute? Write a brief note on it.

**Expected outcome:** The students are able to sincerely evaluate the course and share with their friends. They are also able to suggest measures to make the course more effective and relevant. They are also able to make use of their understanding in the course for a happy and prosperous society.

## Reference Material

The primary resource material for teaching this course consists of

a. The text book

R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics, Excel books, New Delhi, 2010, ISBN 978-8-174-46781-2

b. The teacher's manual

R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics – Teachers Manual, Excel books, New Delhi, 2010

c. A set of DVDs containing

- Video of Teachers' Orientation Program
- PPTs of Lectures and Practice Sessions
- Audio-visual material for use in the practice sessions

In addition, the following reference books may be found useful for supplementary reading in connection with different parts of the course:

1. B L Bajpai, 2004, *Indian Ethos and Modern Management*, New Royal Book Co., Lucknow. Reprinted 2008.
2. PL Dhar, RR Gaur, 1990, *Science and Humanism*, Commonwealth Publishers.
3. Sussan George, 1976, *How the Other Half Dies*, Penguin Press. Reprinted 1986, 1991
4. Ivan Illich, 1974, *Energy & Equity*, The Trinity Press, Worcester, and HarperCollins, USA
5. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, *limits to Growth*, Club of Rome's Report, Universe Books.
6. Subhas Palekar, 2000, *How to practice Natural Farming*, Pracheen(Vaidik) Krishi Tantra Shodh, Amravati.
7. A Nagraj, 1998, *Jeevan Vidya ek Parichay*, Divya Path Sansthan, Amarkantak.
8. E.F. Schumacher, 1973, *Small is Beautiful: a study of economics as if people mattered*, Blond & Briggs, Britain.
9. A.N. Tripathy, 2003, *Human Values*, New Age International Publishers.

## Relevant websites, movies and documentaries

1. Value Education websites, <http://uhv.ac.in>, <http://www.uptu.ac.in>
2. Story of Stuff, <http://www.storyofstuff.com>
3. Al Gore, *An Inconvenient Truth*, Paramount Classics, USA
4. Charlie Chaplin, *Modern Times*, United Artists, USA
5. IIT Delhi, *Modern Technology – the Untold Story*
6. Gandhi A., *Right Here Right Now*, Cyclewala Productions

**DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY  
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**Evaluation Scheme & Syllabus  
For**

**B.Tech. Third Year  
(Biotechnology)**

**On  
Choice Based Credit System  
(Effective from the Session: 2018-19)**

**DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY  
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**Study and Evaluation Scheme  
B.TECH. BIO-TECHNOLOGY  
(Effective from the session: 2018-19)**

**3<sup>rd</sup> Year, 5<sup>th</sup> Semester**

S. No.	Subject Code	Subject Name	Teaching Deptt.	L-T-P	Th/Lab Marks	Sessional		Total	Credit
						Test	Assig/Att.		
1	RAS501	Managerial Economics	Applied Science	3-0-0	70	20	10	100	3
2	RAS502/ RUC501	Sociology/ Cyber Security	Applied Science	3-0-0	70	20	10	100	3
3	RBT-501	Genetic Engineering	Core Department	3-0-0	70	20	10	100	3
4	RBT-502	Fermentation Biotechnology	Core Department	3-1-0	70	20	10	100	4
5	RBT-503	Bioinformatics-I	Core Department	3-0-0	70	20	10	100	3
6	RBT-051-054	Departmental Elective-I	Core Department	3-1-0	70	20	10	100	4
7	RBT-551	Genetic Engineering Lab	Core Department	0-0-2	50		50	100	1
8	RBT-552	Fermentation Biotechnology Lab	Core Department	0-0-2	50		50	100	1
9	RBT-553	Bioinformatics-I Lab	Core Department	0-0-2	50		50	100	1
10	RBT-554	Nano Biotechnology Lab	Core Department	0-0-2	50		50	100	1
	<b>Total</b>							<b>1000</b>	<b>24</b>

**Departmental Elective-I**

RBT051: Pharmaceutical Biotechnology

RBT052: Nano Biotechnology

RBT053: Biomedical Instrumentation

RBT054: Metabolic Engineering

## **RBT-501: Genetic Engineering**

<b>L</b>	<b>T</b>	<b>P</b>
<b>3</b>	<b>1</b>	<b>0</b>

### **Unit I (10)**

Gene cloning- concept and basic steps; Restriction modification enzymes used in recombinant DNA technology, endonucleases, ligases and other enzymes useful in gene cloning; Vectors: plasmid, bacteriophage and other viral vectors, cosmids, artificial chromosomes, yeast artificial chromosome, Bacterial Artificial Chromosome, Ti plasmid, shuttle vectors, expression vectors; DNA delivery methods; Construction of genomic and cDNA libraries; Techniques for selection, screening and characterization of transformants (hybridization based techniques, expression & interaction based techniques).

### **Unit II (8)**

Concept of PCR; DNA polymerases; primer designing, linkers, adapters, setting up PCR reactions; Various types of PCR; Applications of PCR in disease diagnostics, forensic sciences and genetic engineering.

### **Unit III (6)**

Gene expression in prokaryotes & eukaryotes, Tissue specific promoter, wound inducible promoters, Strong and regulatable promoters, promoter analysis (EMSA and DNA footprinting), gene expression profiling (real time PCR, SAGE, differential display, Microarray); DNA sequencing methods; Molecular markers: RAPD, RFLP, AFLP, SNP; Site directed mutagenesis, gene silencing techniques.

### **Unit IV (6)**

Applications of genetic engineering; Creation of recombinant microorganisms, transgenic plants and animals; cloning of sheep (Dolly) & other mammals; applications in conservation; therapeutic vs. reproductive cloning; ethical issues and the prospects for human cloning; Gene therapy; DNA drugs and vaccines.

### **Unit V (10)**

Basic concepts of cell signaling, Extracellular signal molecule and their receptors, Operation of Signaling molecules over various distances, Cellular response to specific combinations of extracellular signal molecules; Nuclear receptor; Ion channel linked, G-protein mediated receptors, Relay of signal by activated cell surface receptors via intracellular signaling proteins, Intracellular Signaling proteins as molecular switches.

### **Text books and references**

1. T.A Brown (2006). Gene cloning and DNA analysis, WILEY-BLACKWELL
2. Genetic Engineering by Dr Smita Rastogi & Dr Neelak Pathak, Oxford University Press
3. S.B Primrose (2001). Molecular biotechnology. Panima Publishing corporation, 2<sup>nd</sup> edition
4. Molecular Cloning, A laboratory Manual. Sambrook, J., Fritsch, E.F., Mariatis.3rd edition
5. Genetic Engineering, Principles & Practice by Sandhya Mitra, McGraw Hill Education.

## **RBT-502: Fermentation Biotechnology**

<b>L</b>	<b>T</b>	<b>P</b>
<b>3</b>	<b>1</b>	<b>0</b>

### **Unit I**

**8**

Introduction to fermentation technology: Interaction between Bio-chemical engineering, Microbiology and Biochemistry. History and development of fermentation industry: Introduction to submerged and solid state fermentation, Microbial culture selection for fermentation processes. Primary and Secondary metabolites.

### **Unit II**

**6**

Raw material availability, quality, processes and pretreatment of raw materials. Major alcoholic raw materials. Applications of the nonconventional raw materials (cellulosic material and hydrocarbons).

### **Unit III**

**8**

Different regulatory mechanisms involved in controlling the catabolic and anabolic processes of microbes. Induction, nutritional repression, carbon catabolite repression, crabtree effect, feedback inhibition and feedback repression.

### **Unit IV**

**10**

Creation/procedures for developing mutants of the desired microbes with the stable capacity of producing desired metabolites. Isolation and preservation of different types of mutants induction resistant, feedback inhibition resistant. Concept for over production of primary and secondary metabolites.

### **Unit V**

**8**

Details of the process, parameters and materials -for the industrial manufacture of Antibiotics ( $\beta$ -lactum), Solvents (acetone) Amino acid (Lysine), Organic acids (Citric acid), Alcohols (Ethanol), Ind. Enzymes (Protease/Amylase) and Biopharmaceuticals (Insulin/Interferon etc.)- Microbial Transformations, Microbial leaching.

### **Text books and References:**

1. Murray Moo -Young , Comprehensive Biotechnology, Vol. 1 & III-latest ed.
  2. Microbes & Fermentation, A. Lel and Kotlers Richard J. Mickey, Oriffin Publication
  3. Industrial Fermentations- Leland, N. Y. Chemical Publishers.
  4. Prescott and Dunn's- Industrial Microbiology, 4 th, ed.
  5. Biotechnology Series, Rehm, Reed & Weinheim, Verlag-Chemie.
  6. Biochemical Engg., Aiba, Humphrey & Miller, Academic Press.
- Fermentations & Enzyme technology, Wang & Humphrey, Wiley & Inter Scienceiotechnology

## **RBT-503: Bioinformatics-I**

<b>L</b>	<b>T</b>	<b>P</b>
<b>3</b>	<b>1</b>	<b>0</b>
		10

### **Unit I**

Introduction to Bioinformatics; Biological databases: Nucleotide databases, Protein databases, Specialized databases; Laboratory data submission and data retrieval; Various file formats for biomolecular sequences: Genbank, EMBL, Fasta, GCG, msf, nbrf-pir etc.; Basic concepts of sequence similarity: identity and homology, definitions of homologues, orthologues, paralogues; Sequence patterns and profiles: Basic concept and definition of sequence patterns, motifs, domains and profiles; various types of pattern representations viz. consensus, regular expression (prosite-type) and profiles.

### **Unit II**

08

Sequence Alignment: Pairwise sequence alignments: Dot matrix for sequence alignment, Dynamic programming for Local and Global alignment; Multiple sequence alignment: progressive method and Iterative method; Applications of pairwise and multiple sequence alignment; Tools for multiple sequence alignment: CLUSTALW and Pileup (Algorithmic concepts).

### **Unit III**

10

Scoring Matrices: Basic concept of a scoring matrix, Similarity and distance matrix, Substitution matrices: Matrices for nucleic acid and proteins sequences, PAM and BLOSUM series, principles based on which these matrices are derived; Sequence-based database searches: Need of sequence based database search, BLAST and FASTA algorithms, Various versions of basic BLAST and FASTA, Advance version of BLAST: PHI-BLAST and profile-based database searches using PSIBLAST.

### **Unit IV**

06

Phylogenetics: Phylogeny and concepts in molecular evolution; nature of data used in taxonomy and phylogeny; definition and description of Phylogenetic trees and various types of trees; Different methods of Phylogenetic tree construction: UPGMA and Fitch-Margoliash Algorithm; case studies in phylogenetic sequence analysis.

### **Unit V**

08

Protein structure prediction: Secondary structure prediction (Statistical method: Chou Fasman and GOR method, Neural Network and Nearest neighbor method) and Tertiary structures prediction (Homology Modeling); Structure visualization methods (RASMOL, CHIME etc.); Protein Structure alignment and analysis. Application of bioinformatics in drug discovery and drug designing.

### **Text books and References**

1. D.W.Mount; Bioinformatics- Sequence and genome analysis; Cold Spring Harbour Lab

- press.
2. B.N.Mishra; Bioinformatics: Concept and application, Pearson Education (in press)
  3. O' Reilly; Developing Bioinformatics computer skills- 1<sup>st</sup> Indian edition, SPD publication.
  4. Anthony J.F. Griffiths et al; An introduction to genetic analysis, 1<sup>st</sup> Ed.
  5. Michael Starkey and Ramnath Elaswarapu; Genomics protocols, Humana press.
  6. Stephen Misner & Stephen Kraetz; bioinformatics- Methods and protocols, Humana press.
  7. Lawrence Hunter –Artificial intelligence & Molecular Biology, free on web
  8. Westhead, P; instant notes in bioinformatics; viva publications.
  9. Hooman H Rasid; Bioinformatics basics- Application in biological science and medicine; CRC press.

### **RBT-011: Pharmaceutical Biotechnology**

<b>L</b>	<b>T</b>	<b>P</b>
<b>3</b>	<b>1</b>	<b>0</b>

#### **Unit I (10)**

Introduction: Therapeutic categories such as vitamins, laxatives, analgesics, Antibiotics, biologicals, hormones. non-steroidal contraceptives, male contraceptives, Use and applications of female contraceptives, Ethical aspects.

#### **Unit II (8)**

Bulk drug manufacturers, Type of reactions in bulk drug manufacture and processes. Special requirement for bulk drug manufacture.

#### **Unit III (12)**

Compressed table, wet granulation-dry granulation or slugging-direct compression-tablet presses, coating of tablets, capsules, sustained action dosage forms-parental solution-oral liquids-injections-ointment-topical applications, Preservation, analytical methods and test for various drug and pharmaceuticals, packing-packing techniques, quality management, GMP.

#### **Unit IV (10)**

Development of Drug and Pharmaceutical Industry: Therapeutic agents, their use and economics; Regulatory aspects. Drug metabolism: physico-chemical principles, radio activity pharmacokinetic action of drugs in human bodies.

#### **Unit V**

#### **Reference Books:**

1. Leon Lachman et al Theory and Practice of Industrial Pharmacy, 3 Edition, Lea and Febiger, 1986
2. Remington's Pharmaceutical Science, Mark Publishing and Co.

## **RBT-012: Nano Biotechnology**

<b>L</b>	<b>T</b>	<b>P</b>
<b>3</b>	<b>1</b>	<b>0</b>

### **UNIT-I** **8**

Nanobiotechnology, History, Origin, Fundamental Concepts, Bottom-up versus Top-down approaches, Discussion on Micro and Nanofabrication, Current research, Tool and Techniques, Applications and Implications and Nanofabrication.

### **UNIT-II** **8**

Carbon nanotubes and related structures, Properties, Synthesis, Applications, Metal nano particles types and their synthesis, Application of Gold, Silver and Zinc oxide nanoparticles and Nano chemicals.

### **UNIT-III** **8**

Atomic force microscopy (AFM), Scanning tunneling microscopy (STM), improved nano diagnostic devices, Drug delivery tools through nanotechnology

### **Unit IV** **8**

Synthesis and characterization of different classes of biomedical polymers- their uses in pharmaceutical, cardiovascular ophthalmologic orthopedic areas.

### **UNIT-V** **8**

Micro and Nano biosensor, Bioavailability, Nanoimaging agents, Tumor Targeting through nanotechnology, Quantum dots technology and its applications

## **TEXT BOOK:**

1. Nanotechnology by Mark Ratner and Daniel Ratner, Pearson Education
2. Guozhong Cao ,”*Nanostructures and Nanomaterials , synthesis , properties and applications*” , Imperial College Press ,2004.
3. Hari Singh Nalwa, “*Nanostructured Materials and Nanotechnology*”, Academic Press, 2002
4. Microfabrication and Nanomanufacturing- Mark James Jackson.
5. MEMS and nanotechnology – Based sensors and devices communication, Medical and Aerospace applications - A.R.Jha.
6. Drug Delivery: Engineering Principles for Drug Therapy, M. Salzman,
7. Kazuaki Suzuki, Bruce W.Smith. Microlithography: Science and Technology, CRC Press, ISBN: 978-0824790240.
8. Mihail C. Roco and William Sims Bainbridge, “Nanotechnology: Societal Implications II – Individual Perspectives“, Springer Publishers, Sponsored by National Science Foundation, ISBN-10 1-4020-4658-8.

## **REFERENCE BOOKS:**

1. G.A. Ozin and A.C. Arsenault, "Nanochemistry : A chemical approach to nanomaterials", Royal Society of Chemistry, 2005.
2. T. Pradeep , "*NANO The Essential , understanding Nanoscience and Nanotechnology*". Tata McGraw-Hill Publishing Company Limited , 2007.
3. Charles P.Poole Jr. "*Introduction to Nanotechnology*", John Willey & Sons , 2003.
4. Nanomedicine, Vol. IIA: Biocompatibility by Robert A. Freitas Fabrication of fine pitch gratings by holography, electron beam lithography and nano-imprint lithography (Proceedings Paper) Author(s): Darren Goodchild; Alexei Bogdanov; Simon Wingar; Bill Benyon; Nak
5. Kim; Frank Shepherd. A Three Beam Approach to TEM Preparation Using In-situ Low Voltage Argon Ion Final Milling in a FIBSEM Instrument E L Principe, P Gnauck and P Hoffrogge, Microscopy and Microanalysis (2005), 11: 830-831 Cambridge University Press.
6. Biomedical applications of nanotechnology edited by Vinod Labhasetwar and Diandra L. Leslie – Pelecky.

### **RBT-013: Biomedical instrumentation**

<b>L</b>	<b>T</b>	<b>P</b>
<b>3</b>	<b>0</b>	<b>0</b>

#### **UNIT I**

**8**

History and development of biomedical instrumentation, biometrics, Basic transducer principles: active and passive transducers, transducers for biomedical applications; origin of biopotential and its propagation, sources of bioelectric potentials, electrocardiogram, electroencephalogram, electromyogram and other bioelectric potentials. Biopotential Electrodes: types of electrode surface, needle and microelectrodes, biochemical transducers.

#### **UNIT II**

**8**

The Cardiovascular system, Cardiovascular measurements: electrocardiography, measurement of blood pressure, measurement of blood flow and cardiac output, plethymography, measurement of heart sounds; Patient care and monitoring: elements of intensive care unit, pacemakers and defibrillators, Measurements in the respiratory system: mechanics of breathing, gas exchange and distribution, respiratory therapy equipment.

#### **UNIT III**

**8**

Non-invasive diagnostic instrumentation: Temperature measurements ultrasonic measurements, the nervous system and neuronal communication measurement in nervous systems, Instrumentation for sensory measurements and the study of behaviors, psychophysiological measurements, Biotelemetry.

#### **UNIT IV**

**8**

Instrumentation for the clinical laboratory, Automation of chemical tests, Biomedical instruments for surgery, Haemodialysis machines. X-ray machines and digital radiography.

#### **UNIT V**

**8**

Medical Imaging equipments, the computer in biomedical instrumentation and applications, microprocessors, Electrical safety of medical equipment, physiological effects of electric current.

**Recommended books:**

1. Biomedical Instrumentation and Measurement by Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer
2. Biomedical Instrumentation: Technology and Applications by Raghbir Singh
3. Medical Instrumentation for Health Care by Leslie Cromwell
4. Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation by Robert B. Northrop
5. Introduction to Bioinstrumentation: With Biological, Environmental, and Medical Application by Clifford D. Ferris.

**RBT-014: Metabolic Engineering**

L	T	P
3	1	0

**UNIT I****6**

Concept of metabolism, anabolism & catabolism, General Principles of Intermediary Metabolism, Regulation of Pathways, Strategies for Pathway Analysis.

**UNIT II****8**

Glycolysis: Electron and ATP Tracking, Regulation of glycolysis; Gluconeogenesis: Reaction basis, Regulation of gluconeogenesis; Pentose Phosphate Pathway: Control of Pentose Phosphate Pathway. The Tricarboxylic Acid Cycle: Discovery of the TCA Cycle, Steps in the TCA Cycle, Stereochemical Aspects of TCA Cycle Reactions, Regulation of TCA Cycle Activity.

**UNIT III****8**

Electron Transport and Oxidative Phosphorylation : The Mitochondria Electron - Transport Chain, Oxidative Phosphorylation, Transport of Substrates, Pi, ADP and ATP into and out of Mitochondria, Electron Transport and ATP Synthesis in Bacteria.

**UNIT IV****8**

Photosynthetic Processes Involving Light: Photosynthesis, Other Biochemical Processes Involving Light. Metabolism of Fatty Acids: Fatty Acid Degradation, Biosynthesis of Saturated Fatty Acids, Regulation of Fatty Acid Metabolism.

**UNIT V****8**

Metabolic Organization and Regulation of metabolism, Signal Transduction, Regulation of Metabolism for the production of Primary and Secondary Metabolites with Case studies, Plasma Membrane: Structure and Transport, Protein Targeting

**References:**

1. Wang D. I. C., Cooney C. L., Demain A. L., Dunnill P., Humphrey A. E., Lilly M. D., Fermentation and Enzyme Technology, John Wiles and Sons., 1980.
2. Stanbury P. F. and Whitaker A., Principles of Fermentation Technology, Pergamon Press, 1984.
3. Zubay G., Biochemistry, Macmillan Publishers, 1989.
4. Metabolic engineering edited by Sang Yup Lee and Eleftherios T. Papoutsakis

5. Metabolic engineering - Principles and Methodologies by Gregory N. Stephanopoulos, Aristos A. Ariostidou and Jens Nielsen.

**RBT-551: Genetic Engineering Lab**

L	T	P
0	0	3

1. Estimation of DNA by diphenylamine reaction
2. Determination of RNA by orcinol method
3. To isolate plant DNA using CTAB.
4. Elution of plant DNA fragment from agarose gel
5. To perform restriction digestion of  $\lambda$  DNA
6. Dephosphorylation of restriction enzyme digested vector pUC18.
7. To make bacterial cells competent for transformation
8. To perform transformation of the desired bacterial strain with plasmid DNA
9. SDS-PAGE of proteins under reducing conditions (SDS-PAGE)
10. To perform Southern Hybridization
11. To perform ligation of  $\lambda$  *EcoRI* digest using T<sub>4</sub> DNA ligase

**RBT-552: Fermentation Biotechnology Lab**

L	T	P
0	0	3

1. Fermentative production of Penicillin Antibiotics using *Penicillium chrysogenum*.
2. To study the induction effect of  $\beta$ -galactosidase enzyme in *E.coli*.
3. Upstream and Downstream of bioprocess for the production of Citric acid by *Aspergillus niger*
4. Citric acid production from whey with glucose as supplementary carbon source by *Aspergillus niger*
5. Microbial production of citric acid by solid state fermentation process.
6. Microbial production of enzymes by (a) solid state and (b) submerged fermentation.
7. Fermentative production of Ethanol using *Saccharomyces cerevisiae*.

8. Wine Fermentation.
9. Microbial production of Biosurfactant using suitable strain.
10. Microbial production of Biopolymer using suitable Strain.
11. Computational Design of Fermentative Process

### **RBT-553: Bioinformatics-I Lab**

<b>L</b>	<b>T</b>	<b>P</b>
<b>0</b>	<b>0</b>	<b>2</b>

1. Get five nucleotide and five protein sequences in FASTA format from NCBI and EMBL.
2. To find out five similar sequences for any nucleotide and protein query sequence using BLAST and FASTA.
3. Access and use of different online nucleotide and protein alignment tools (Pairwise and Multiple sequence alignment).
4. Genes and Exons identification related search for a given genome sequence in order to predict the gene.
5. ORF prediction in the given nucleotide sequence.
6. Secondary structure prediction for given amino acid sequences of a given protein using Chou Fasman, GOR method and Neural Network method.
7. Visualize tertiary structure of any given protein sequence.
8. Carry out the alignment of genomes of given organisms.
9. Predict the homology model of any protein sequence.

### **Text books and References**

1. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by Andreas D. Baxevanis
2. Structural Bioinformatics by Philip E Bourne, John Wiley & Sons
3. Analytical Tools for DNA, Genes & Genomes: by Arseni Markoff, New Age.

## **RBT-554: Nanobiotechnology Lab**

<b>L</b>	<b>T</b>	<b>P</b>
<b>0</b>	<b>0</b>	<b>2</b>

1. Introduction to nanoscience and nanobiotechnology (Size comparative analysis)
2. Synthesis and characterization of carbon nanotubes from carbon source.
3. Chemical synthesis of silver and gold nanoparticles; UV-Visible absorption of the colloidal solution and estimation of size by curve fitting.
4. Biological synthesis of silver and gold nanoparticles; UV-Visible absorption of the colloidal solution and estimation of size by curve fitting.
5. Metal nanoparticles toxicity estimation in percentage as *in vitro*
6. Metal nanoparticles toxicity estimation as *in vivo*
7. Sol gel synthesis of zinc oxide nanoparticles.
8. Antibacterial activities of silver and zinc nanoparticles, against bacterial cultures performed by standard disc diffusion method.
9. Nature of Interaction between nanoparticles & Bacterial Cell (*E. coli* and *B. subtilis*).
10. Demonstration of nano characterization tools and techniques.

### **Reference books:**

- Nanotubes and Nanowires- CNR Rao and A Govindaraj RCS Publishing
- Drosophila Nanotoxicity Analysis: A Practical Approach – Pankaj Kumar Tyagi (1<sup>st</sup> Eds.), 2017 New Delhi BIRDS Press.

**DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY  
LUCKNOW**

**Study and Evaluation Scheme  
B.TECH. BIO-TECHNOLOGY  
(Effective from the session: 2018-19)**

**3<sup>rd</sup> Year, 6<sup>th</sup> Semester**

S. No.	Subject Code	Subject Name	Teaching Deptt.	L-T-P	Th/Lab Marks	Sessional		Total	Credit
						Test	Assig/Att		
1	RAS601	Industrial Management	Applied Science	3-0-0	70	20	10	100	3
2	RUC601 / RAS602	Cyber Security/ Sociology	Applied Science	3-0-0	70	20	10	100	3
3	RBT601	Bioprocess Engineering	Core Department	3-0-0	70	20	10	100	3
4	RBT602	Plant Biotechnology	Core Department	3-1-0	70	20	10	100	4
5	RBT603	Bioinformatics-II	Core Department	3-0-0	70	20	10	100	3
6	RBT061-064	Departmental Elective-II	Core Department	3-1-0	70	20	10	100	4
7	RBT651	Bioprocess Engineering Lab	Core Department	0-0-2	50		50	100	1
8	RBT652	Plant Biotechnology Lab	Core Department	0-0-2	50		50	100	1
9	RBT653	Bioinformatics-II Lab	Core Department	0-0-2	50		50	100	1
10	RBT654	Food Biotechnology Lab	Core Department	0-0-2	50		50	100	1
	<b>Total</b>							<b>1000</b>	<b>24</b>

**Departmental Elective-II**

- RBT-061: Animal Biotechnology
- RBT-062: Biomarker & Diagnostics
- RBT-063: Food Biotechnology
- RBT-064: Entrepreneurship in Biotechnology

## **RBT-601: Bioprocess Engineering**

<b>L</b>	<b>T</b>	<b>P</b>
<b>3</b>	<b>1</b>	<b>0</b>

(8)

### **Unit I**

Media Preparation, Media design and optimization. Microbial growth patterns and kinetics in batch culture, Microbial growth parameters, Environmental conditions affect growth kinetics, Kinetics of thermal death of microorganisms, Heat Generation by microbial growth, Quantitative analysis of microbial growth by direct & indirect methods.

### **Unit II**

(8)

Sterilization: concept and methods. Type of Sterilizations, Batch heat sterilization of liquids, Estimation of sterilizer efficiency, Continuous heat sterilization of liquids, Sterilization of air: Methods & Mechanism, Design of depth filter and estimation of its efficiency. Stoichiometric calculations, Theoretical prediction of yield coefficients, Stoichiometry of growth and product formation, Maximum possible yield, Theoretical oxygen demand, Stoichiometry of single-cell protein synthesis.

### **Unit III**

(8)

Ideal Reactor Operation: Batch, Fed Batch & Continuous operation of mixed bioreactors, Microbial pellet formation, Kinetics and dynamics of pallet formation. Chemostate with immobilized cells, Chemostate with cell recycle, substrate utilization and product formation in bioreactor, Scale up of Bioreactors

### **Unit IV**

(8)

Role of diffusion in Bioprocessing, Convective mass transfer, Gas-liquid mass transfer, Oxygen uptake in cell cultures, Factor affecting cellular oxygen demand, Oxygen transfer in bioreactors, Measurement of volumetric oxygen transfer coefficient, Oxygen transfer in large bioreactor.

### **Unit V**

(8)

Bioreactor control mechanism, Physical, Chemical and Biological environment of bioreactor, Manual control system, Role of physical, chemical & biological sensors, Advanced control strategies viz. PID controllers, Fuzzy logic based controllers and artificial neural network based Controllers. Basic concepts of computer modeling and optimization in bioprocess applications.

### **Text Books and Reference Books**

1. Principles of Microbe and cell cultivation- S. John Pirt, Butterworth Publication.
2. Bioprocess Engineering Principles – P. M. Doran, 5th ed.
3. Hand Book Of Bioengineering- Skalak R & Shu Chien, 4th ed.
4. Biochemical Engg. Bailly & Ollis, Academic Press
5. Introduction to Chemical Engg. Series, MCH Int. Series.
6. Biochemical & Biological Engg. Science, N. Blakebraugh, Academic Press
7. "Principles of fermentation technology" by P F Stanbury and A Whitaker, Pergamon press.
8. "Bioprocess Technology - Kinetics & Reactors" by A Moser, Springer-Verlag.
9. "Biochemical Engineering and Biotechnology Handbook" by B. Atkinson & F. Mavituna, 2nd Ed. Stockton Press.
10. Biochemical Engineering- S. Aiba , A.E. Humphray, University of Tokyo Press.
11. Bioreactor Design & Product Yield, BIOTOL Series
12. Bioreactors in Biotechnology: A Practical approach by Scragg
13. Process Biotechnology Fundamentals by S.N. Mukopadhyay
14. Bioprocess Engineering: Basic Concepts by Shular & Kargi
15. Fermentation Microbiology & Biotechnology by Mansi

## RBT-602: Plant Biotechnology

L	T	P
3	1	0
		10

### Unit I

Introductory history of plant biotechnology: Laboratory organization; Principles of Plant Tissue Culture. Concepts of totipotency, competency, determinism, explants, inoculums, Acclimatization.. Nutrition of plant cells; Nutrient media: Composition of commonly used nutrient culture media with respect to their contents like inorganic chemicals, organic constituents. An appraisal of different media, selection of media, Sterilisation of the media. Hormones: Auxins, cytokinins, Gibberellins, Abscisic Acid, ethylene etc. Explant preparation and Surface sterilization. Basic procedure for Aseptic Tissue transfer.

### UNIT-II

10

Culture of plant materials- explants selection and technique of culturing. Organogenesis, Embryogenesis, Somaclonal variation, germiclonal variation Establishment, growth and maintenance of Callus and cell suspension culture, Methods of sub culturing and transfer of regenerated plants to the field. Tissue and organ culture; Cellular differentiation and regulation of morphogenesis;. Somatic embryogenesis; Control of organogenesis and embryogenesis; Single cell culture

### Unit III

8

Haploid production -Androgenesis; Anther and microspore culture; Gynogenesis; Embryo culture and rescue in agricultural and horticultural crops; Protoplast isolation; Culture–regeneration; Somatic hybrid-cybrids; *In vitro* selection of mutants – mutants for salts, disease, cold, drought, herbicide and other stress conditions; Micropropagation: Application of micropropagation in agriculture and forestry . Meristem culture and virus elimination; Shoot tip culture.

### Unit IV

8

Improved crop varieties through somaclonal variation in *in vitro* cultures -- Causes- stability and utilization – genetic and epigenetic basis; Establishment of cell lines and evaluation. Application of tissue culture for crop improvement in agriculture, horticulture and forestry. Cryopreservation and slow growth cultures, Freezing and storage, thawing, reculture. Application of plant tissue culture in transgenic plants and production of secondary metabolites and industrial products.

### Unit V

8

Genetic transformation using Ti plasmid Manipulation of gene expression in plants; Production of marker free transgenic plants. Developing insect-resistance, disease-resistance, herbicide resistance; stress and senescence tolerance in plants. Genetic manipulation of flower pigmentation, Developing quality of seed storage, Provitamin A, iron proteins in rice, Modification of food plant taste and appearance, yield increase in plants

### References:

1. Hudson T Hartmann: Plant Propagation-Principle and Practices
2. Principles of Plant Biotechnology- An Introduction of Genetic Engineering in Plants by S.H. Mantell, J.W. Mathews and R.A. Mckee, Blackwell Scientific Publications.
3. Chopra V L, Sharma R P & Swaminathan M S: Agricultural Biotechnology
4. Hamish A, Collin & Sue Edwards: Plant Cell Culture
5. Razdan M K: An Introduction to Plant Tissue Culture
6. Introduction to Plant Tissue Culture, Bhojwani and Rozdan
7. H.S. Chawla. Plant Biotechnology, Oxford IBH publications

## **RBT-603: Bioinformatics-II**

<b>L</b>	<b>T</b>	<b>P</b>
<b>3</b>	<b>1</b>	<b>0</b>

### **Unit I** [10]

Inference problems and techniques for molecular biology. Overview of key inference problems in biology: Homology identification, Genomic sequence annotation (Genes and ORFs identification), Protein structure prediction (Secondary and Tertiary structure prediction), Protein function prediction, Biological network identification, Next generation sequencing, Microarray data analysis.

### **Unit II** [8]

Basics of RNA Structure prediction and its limitations, Features of RNA Secondary Structure, RNA structure prediction methods: Based on self-complementary regions in RNA sequence, Minimum free energy methods, Suboptimal structure prediction by MFOLD, Prediction based on finding most probable structure and Sequence co-variance method. Application of RNA structure modeling.

### **Unit III** [10]

Machine learning: Decision tree induction, Artificial Neural Networks, Hidden Markov Models, Genetic Algorithms, Simulated Annealing, Support vector machines; The relation between statistics and machine learning; Evaluation of prediction methods: Parametric and Non-parametric tests, cross-validation and empirical significance testing (empirical cycle), Clustering (Hierarchical and K-mean).

### **Unit IV** [6]

Basic concept of Force field in molecular modeling (Potential energy calculation); Overview of key computational simulation techniques: Introduction to simulation, Computer simulation techniques, Types of computer simulation (Continuous, Discrete-event and Hybrid simulation), Differential equation solvers, Parameter estimation, and Sensitivity analysis.

### **Unit V** [8]

Overview of key techniques for the management of large document collections and the biological literature: Document clustering, Information retrieval system; Natural Language Processing: Introduction, Major areas of NLP, Natural language information extraction; Insilico Drug Designing: Major steps in Drug Designing, Ligand and Structure based drug designing, Protein-ligand docking, QSAR Modeling, Pharmacodynamics (Efficacy & Potency) & Pharmacokinetics (ADME), Lipinski's rule of five, Pharmacogenomics.

### **Text Books & References**

1. Computational Methods in Biotechnology – Salzberg S. L. et al., Elsevier Science.
2. D.W.Mount; Bioinformatics- Sequence and genome analysis; Cold Spring Harbour Lab

press.

3. Statistical Methods in Bioinformatics-Evens & Grants, Springer-Verlag, NY.
4. Computational Molecular Biology- Setubal and Meidanis, PWS publishing Co., 1997. 18/ 24
5. Protein Structure Prediction-A Practical Approach, MJE Sternberg, Oxford University Press.
6. Purifying Protein for Proteomics, Richard J. Simpson, I.K. International Pvt. Ltd.

### **RBT-021: Animal Biotechnology**

<b>L</b>	<b>T</b>	<b>P</b>
<b>3</b>	<b>1</b>	<b>0</b>

#### **Unit I**

**8**

Basic cell culture techniques, Types of cell culture media; Ingredients of media; Physiochemical properties; CO<sub>2</sub> and bicarbonates; Buffering; Oxygen; Osmolarity; Temperature; Surface tension and foaming; Balance salt solutions; Antibiotics growth supplements; Foetal bovine serum; Serum free media; Trypsin solution; Selection of medium and serum; Conditioned media; Other cell culture reagents; Preparation and sterilization of cell culture media, serum and other reagents.

#### **Unit II**

**8**

Different tissue culture techniques; Types of primary culture; Chicken embryo fibroblast culture; Chicken liver and kidney culture; Secondary culture; Trypsinization; Cell separation; Continuous cell lines; Suspension culture; Organ culture etc.; Behavior of cells in culture conditions: division, growth pattern, metabolism of estimation of cell number; Development of cell lines; Characterization and maintenance of cell lines, stem cells; Cryopreservation; Common cell culture contaminants.

#### **Unit III**

**8**

Cell cloning and selection; Transfection and transformation of cells; Commercial scale production of animal cells, stem cells and their application; Application of animal cell culture for *in vitro* testing of drugs; Testing of toxicity of environmental pollutants in cell culture; Application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins.

#### **Unit IV**

**8**

Cell culture reactors; Scale-up in suspension; Scale and complexity; Mixing and aeration; Rotating chambers; Perfused suspension cultures; Fluidized bed reactors for suspension culture; Scale-up in monolayers; Multisurface propagators; Multiarray disks, spirals and tubes; Roller culture; Microcarriers; Perfused monolayer cultures; Membrane perfusion; Hollow fiber perfusion; Matrix perfusion; Microencapsulation; Growth monitoring

#### **Unit V**

**8**

Transgenic animal production; Methods of transgene delivery; Integration of foreign genes and their validation; Gene targeting; Methods and strategies; Improving transgene integration efficiency; Cell lineages and developmental control genes in drosophila and mice; Differentiation of germ layers; Cellular polarity; Stem cell differentiation; Blood cell formation; Fibroblasts and their differentiation; Differentiation of cancerous cells and role of protooncogenes;

### **Texts/References:**

1. B. Hafez and E.S.E Hafez, Reproduction in farm animals, 7<sup>th</sup> Edition, Wiley Blackwell, 2000
2. G.E. Seidel, Jr. and S.M. Seidel, Training manual for embryo transfer in cattle (FAO Animal Production and Health Paper-77), 1st Edition, W.D. Hoard and sons FAO, 1991
3. I. Gordon, Laboratory production of cattle embryos, 2nd edition, CAB International, 2003.
4. Louis-Marie Houdebine, Transgenic Animals: Generation and Use 5<sup>th</sup> Edition, CRC Press, 1997.

### **RBT-022: Biomarker & Diagnostics**

<b>L</b>	<b>T</b>	<b>P</b>
<b>3</b>	<b>1</b>	<b>0</b>

#### **Unit – I**

**12**

**Introduction to Molecular Diagnostics:** History of diagnostics, Age of molecular diagnostics, Significance, Scope, Rise of diagnostic industry in Indian and global scenario, **Cellular Complexity:** Cell components, Cell Differentiation, Cellular communication – endocrine signalling, paracrine signalling and autocrine signalling, contact dependent and synaptic communications, Intracellular networks – transport pathways, signalling pathways and metabolic networks. Eukaryotic Cell Control System and their Components, Intracellular cell cycle control system, Extracellular Cell Cycle Control System, Regulation of Cell Growth and Apoptosis, Genetic and epigenetic factors that regulate these pathways, their abnormalities that alter the pathways and cellular functions.

#### **Unit – II**

**08**

**Molecular Oncology Mitochondrial disorders:** Cancer – Benign and Malignant neoplasms, multifactorial disposition, Cancer pathogenesis, positive and negative mediators of neoplastic development, Proto-oncogenes, Oncogenes and Tumor suppressors. Allele loss and loss of Heterozygosity. Mitochondrial inheritance, Mitochondrial myopathy, lactic acidosis, MELAS, LHONs, identity testing.

#### **Unit – III**

**06**

**Biomarkers in disease diagnostics:** FDA definition of disease markers, Role of markers in Disease diagnosis. Approaches and methods in the identification of disease markers, predictive value, diagnostic value, emerging blood markers for sepsis, tumour & cancer markers, markers in inflammation and diagnosis of cytoskeletal disorders.

#### **Unit – IV**

**10**

**Chromosomes, Human disorders, and Cytogenetic analysis :**Structure, types and organization; Chromosome organization, Euchromatin and heterochromatin and Histone modifications. Chromosome banding and nomenclature; Nomenclature and functional significances of chromosome bands. GC and AT rich isochores. Structural and Numerical aberrations and its consequences. X-chromosome dosage compensation and inactivation mechanism. Sex determination and Y chromosome; function, and diseases. Uniparental disomy, Genomic Imprinting and disorders. FISH, CGH, Flow cytometry techniques and clinical diagnostics.

**Unit – V****10**

**Genomic instability, Chromosome mapping & Genome plasticity:** Common fragile sites and methods of induction, Heritable fragile sites and FXS. Genomic Instability, mechanism and diseases. Trinucleotide Repeats; Mechanism of expansion and triplet repeats and related disorders. Genetic linkage maps, Relation to the probability of recombination, Pedigree analysis with genetic markers and overview of human genome project.

**References and text books:**

1. Molecular biology of the cell. Bruce Alberts, 6th Edition
2. Principles of tissue engineering. Robert Lanza. Elsevier Publications.
3. Introduction to Tissue engineering, applications and challenges. Ravi Birla. Wiley Publications.
4. Molecular Cell Biology: Darnell J, Lodish H and Baltimore D
5. Cell and Molecular Biology: De Robertis EDP and De Robertis EMF
6. Animal cell culture: Ian Freshney
7. An introduction to Human Molecular Genetics by Pasternak et al., John Wiley & Sons
8. Human Chromosomes by Miller & Tharman, Springer Publishing Company,
9. Molecular Biology of the cell by Alberts et al., Garland Press
10. Genes IX, by Lewin B, Pearson India
11. Cell and Molecular Biology by De Robertis and De Robertis, Lipincott & Wilkins
12. Genome III by Brown TA, Garland Press
13. Elements of medical Genetics by Turnpenny and Ellard, Churchill Livingstone

**RBT-023: Food Biotechnology**

<b>L</b>	<b>T</b>	<b>P</b>
<b>3</b>	<b>1</b>	<b>0</b>

**Unit-I****8**

**History of Microorganisms in food:** Historical Developments. Role and significance of microorganisms in foods. Intrinsic and Extrinsic parameters of foods that affect microbial growth. Basic principles of the equipment involved in the commercially important food processing methods and unit operations.

**Unit-II****10**

**Microorganisms in food:** spoilage of fresh meats and poultry, processed meats, seafood's, fruits and vegetables. Fermented food products, Medical foods, Probiotics and health benefits of fermented milk and foods products. Dehydrated Foods, Enteral Nutrient Solutions (Medical Foods), Single-Cell Protein. Starter cultures, Production process of cheeses, beer, wine and distilled spirits. Process of Brewing, malting, mashing, primary & secondary fermentation. Problems in food industry: catabolic repression, High gravity brewing, B-glucan problem, getting rid of diacetyl.

**Unit-III****8**

**Determining Microorganisms and/or their Products in Foods:** Microbiological Examination of surfaces, Air Sampling, Metabolically Injured Organisms. Enumeration and Detection of Food-borne Organisms. Bioassay and related Methods. Common Food borne diseases. Nutritional boosts and flavor enhancers: Emerging processing and preservation technologies for milk and dairy products.

**Unit-IV****8**

**Food Preservation:** Food preservation by various methods especially Irradiation, Characteristics of radiations in food preservation, principles underlying the destruction of microorganisms by Irradiation. Application of radiations in food (processing for irradiation). Radappertization, Radicidation, and Radurization of Foods. Effect of Irradiation on Food quality and storage ability. Miscellaneous Food Preservation Methods: High- Pressure Processing, Pulsed Electric Fields, Aseptic Packaging, Manothermosonication (Thermo-ultrasonication).

**Unit-V****6**

**Indicators of Food Safety and Quality:** Indicators of Food microbial quality, product quality and food safety. Fecal Indicator Organisms, Predictive Microbiology/Microbial Modeling. The Hazard Analysis Critical Control Point System (HACCP System), Microbiological Criteria. Food borne intoxicants and mycotoxins.

**Text / Reference Books:**

1. Frazier, W.S. and Weshoff, D.C., 1988. Food Microbiology, 4th Edn., McGraw Hill Book Co., New York.
2. Mann & Trusswell, 2007. Essentials of human nutrition. 3rd edition. Oxford University Press.
3. Jay, J.M., 1987. Modern Food Microbiology, CBS Publications, New Delhi.
4. Lindsay, 1988. Applied Science Biotechnology. Challenges for the flavour and Food Industry. Willis Elsevier.
5. Roger, A., Gordon, B. and John, T., 1989. Food Biotechnology.

**RBT-024: Entrepreneurship in Biotechnology**

<b>L</b>	<b>T</b>	<b>P</b>
<b>3</b>	<b>1</b>	<b>0</b>

**Unit-I****8**

Entrepreneur - Meaning of Entrepreneur, Evolution of the Concept, Functions of an Entrepreneur, Types of Entrepreneur, Development of Entrepreneurship steps in entrepreneurial process, Biotech Entrepreneurship in India, Identification of Business Opportunities, Qualities, skills and attributes that successful biotech entrepreneurs possess. Case studies of successful and unsuccessful bio-entrepreneurs

**Unit-II****8**

Business development in biotechnology - Factors affecting biotech business: (finance, infrastructure, equipment, manpower, resources, project location, end product, quality issues, etc) Basic principles and practices of management - Definition, concepts and application; Organization types, coordination, control and decision making in management

**Unit-III****8**

Core concept of Market: Identification and evaluation of market potential of various bio-entrepreneur sectors. Marketing, Marketing research- concept and techniques, Considerations in establishment of biotechnological start-up - Different models of biotechnological start-ups. The

budget for a biotechnological start-up company. Seed capital raising for a biotechnological start-up company

**Unit-IV**

**8**

Role of government and schemes, financial institutions in fostering Bioentrepreneurship, Skills in bio-entrepreneurship-Personality and attitude, Organizational behavior, Leadership, Principles of effective communication Body language, public speaking, presentations, business proposal writing.

**Unit-V**

**8**

Biotechnology: emerging industries with examples from Transgenic, Environmental biotechnology, New drug development, DNA chip technology, Stem cell research, Tissue engineering. Contract Research Organization, marketing consultancy, bio-learning module. Ethics and IPR in biotech-Industries - Fundamentals of ethics in business, Ethical dilemmas in biotech industry, IPR- Introduction, Forms of IPR.

**RBT-651: Bioprocess Engineering Lab**

<b>L</b>	<b>T</b>	<b>P</b>
<b>0</b>	<b>0</b>	<b>3</b>

1. Determine the growth patterns and specific growth rate of *E.coli*
2. Determine the effect of peptone concentration on *E.coli*. growth
3. Determination of specific thermal death rate constant ( $k_d$ ) for *E.Coli*
4. Determine the effects of temperature & pH on *Pseodomonas putida*
5. Upstream and Downstream of bioprocess for the production of Citric acid by *Aspergillus niger*
6. Citric acid production from whey with glucose as supplementary carbon source by *Aspergillus niger*
7. Upstream and Downstream of bioprocess for the production of  $\alpha$ -amylase by *Aspergillus nudulans*
8. Estimation of volumetric liquid mass transfer coefficient ( $K_La$ ) using sodium sulphite method.
9. Preparation of immobilized enzymes & cells and evaluation of kinetic parameters.
10. Computational Design of Fermentative Process for l-Lysine production

### **RBT-652: Plant Biotechnology Lab**

**L**      **T**      **P**  
**0**      **0**      **3**

1. Preparation of Stocks solution for plant tissue culture media.
2. Preparation of MS/B5 medium (semi-solid) and sterilization.
3. Explant selection, preparation and surface sterilization.
4. To learn culturing, sub culturing and maintenance using selected explants.
5. Initiation of *in vitro* cultures through axillary bud induction
6. Initiation of callus cultures from different explants.
7. Preparation of artificial seed/synthetic seed for conservation of germplasm
8. Extraction of DNA/RNA from plants and its estimation.
9. Isolation and characterization of plant secondary metabolites from selected medicinal plants.
10. Extraction of proteins from plants and its estimation

### **RBT-653: Bioinformatics-II Lab**

**L**      **T**      **P**  
**0**      **0**      **3**

1. Identification of Distantly related homologous sequences of a given query protein sequence using PSI-BLAST.
2. Construct Phylogenetic tree of five evolutionary related protein/nucleotide sequences.
3. Prediction of secondary structure of RNA using any web server.
4. Construction and analysis of Ramachandran Plot using any suitable web server.
5. Align two homologous protein structure and calculation the RMSD for the superposition result.
6. Comparative assessment of best available tools for genome annotation.
7. Construction of restriction maps for various vectors used in genetic engineering using tool “NEBcutter”.
8. Primer Design: Construct primers for the given DNA sequence using any suitable web based tool.
9. Generate 2D QSAR model of a set of legend descriptor data using any web based tool.

### **Text books and References**

1. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by Andreas D. Baxevanis
2. Structural Bioinformatics by Philip E Bourne, John Wiley & Sons
3. Analytical Tools for DNA, Genes & Genomes: by Arseni Markoff, New Age

### **RBT-654: Food Biotechnology Lab**

<b>L</b>	<b>T</b>	<b>P</b>
<b>0</b>	<b>0</b>	<b>3</b>

1. Isolation and Characterization of food fermenting organism from idli batter.
2. Estimation of ascorbic acid from given food sample by titrimetric method.
3. Analysis of mycotoxin (Aflatoxin) in fungus contaminated food material.
4. Microscopic examination of Food/Milk by breed method.
5. Estimation of lactose from milk.
6. Quality characterization of pasteurized milk by MBRT method.
7. To judge efficiency of pasteurization of milk by Phosphatase test.
8. Detection of microbial count in Milk by SPC method.
9. Determination of Minimum Inhibitory Concentration (MIC) of Antibiotic.

**DR. A.P.J. ABDUL KALAM TECHNICAL  
UNIVERSITY, LUCKNOW**



**COMMON SYLLABUS  
FOR**

**B. TECH. III YEAR**

**ALL BRANCHES**

**ON**

**CHOICE BASED CREDIT SYSTEM (CBCS)**

**[Effective from the Session: 2018-19]**

<b>RAS501 Managerial Economics</b>		<b>L-T-P: 3-0-0</b>
<b>Unit</b>	<b>Topic</b>	<b>Proposed Lecture</b>
<b>I</b>	<b>Introduction of Engineering Economics and Demand Analysis:</b> Meaning and nature of Economics, Relation between science, engineering, technology and economics; Meaning of Demand, Determinants of Demand, Shifts in demand, Law of Demand, Price Elasticity of Demand &Types, Income Elasticity, Cross price Elasticity, Determinants of Elasticity, uses and importance of elasticity.	<b>06</b>
<b>II</b>	<b>Concept of Supply:</b> Law of Supply, Factors affecting Supply, Elasticity of supply. <b>Demand Forecasting:</b> Introduction, Meaning and Forecasting, Methods or Techniques of Demand Forecasting, Criteria for Good Demand Forecasting, Demand Forecasting for a New Product;	<b>06</b>
<b>III</b>	<b>Cost Analysis-</b> Introduction, Types of Costs, Cost-Output Relationship: Cost Function, Cost-Output Relationships in the Short Run, and Cost-Output Relationships in the Long Run; Short run and long run, Break- Even Analysis; Production functions: laws of variable proportions, law of returns; Economies of scale: Internal and external.	<b>06</b>
<b>IV</b>	Market Structure: Market Structure Perfect Competition, Imperfect competition – Monopolistic, Oligopoly, duopoly sorbent features of price determination and various market conditions.	<b>06</b>
<b>V</b>	Nature and characteristics of Indian economy, concepts of LPG, elementary concepts of National Income, Inflation and Business Cycles ,Concept of N.I. and Measurement., Meaning of Inflation, Types and causes , Phases of business cycle .Investment decisions for boosting economy(National income and per capital income)	<b>06</b>
<b>References:</b>		
<ol style="list-style-type: none"> <li>1. Premvir Kapoor, Sociology and Economics for Engineers, Khanna Publishing House (Edition 2018)</li> <li>2. Salvatore D, “Principles of Microeconomics”, Oxford University Press.</li> <li>3. Koutsoyiannis A, “Modern Microeconomic”, Macmillan Education Ltd.</li> <li>4. Dwivedi DN, “Principles of Microeconomics”, Pearson Education.</li> <li>5. Cowell, FA, “Microeconomic Principles and Analysis”, Oxford University Press.</li> </ol>		

<b>RAS502/ RAS602</b>		<b>SOCIOLOGY</b>	<b>L-T-P: 3-0-0</b>
<b>Unit</b>	<b>Topic</b>		<b>Proposed Lecture</b>
<b>I</b>	Industrial Sociology: Nature, Scope and Importance of Industrial Sociology. Social Relations in Industry, Social Organisation in Industry- Bureaucracy, Scientific Management and Human Relations.		<b>06</b>
<b>II</b>	Rise and Development of Industry: Early Industrialism – Types of Productive Systems – The Manorial or Feudal system. The Guild system, The domestic or putting-out system, and the Factory system. Characteristics of the factory system. Causes and Consequences of industrialization. Obstacles to and Limitations of Industrialization.		<b>06</b>
<b>III</b>	Industrialization in India. Industrial Policy Resolutions – 1956.Science. Technology and Innovation Policy of India 2013.		<b>06</b>
<b>IV</b>	Contemporary Issues: Grievances and Grievance handling Procedure. Industrial Disputes: causes, Strikes and Lockouts. Preventive Machinery of Industrial Disputes: Schemes of Workers Participation in Management- Works Committee, Collective Bargaining, Bi-partite & Tri-partite Agreement, Code of Discipline, Standing Orders. Labour courts & Industrial Tribunals.		<b>06</b>
<b>V</b>	Visualizing the future: Models of industrialization- Collectivist, anarchist, free market, environmentalist, etc. Cultural issues, consumer society and sociological concerns.		<b>06</b>
<b>References:</b>			
<ol style="list-style-type: none"> <li>1. PREM VIR KAPOOR, Sociology &amp; Economics for Engineers, Khanna Publishing House (Edition 2018).</li> <li>2. GISBERT PASCAL, Fundamentals of Industrial sociology, Tata McGraw Hill, New Delhi, 1972.</li> <li>2. SCHNEIDER ENGNO V., Industrial Sociology 2nd Ed., McGraw Hill Publishing Co., New Delhi, 1979.</li> <li>3. MAMORIA C.B. And MAMORIA S., Dynamics of Industrial Relations in India.</li> <li>4. SINHA G.P. and P.R.N. SINHA, Industrial Relations and Labour Legislations, New Delhi, Oxford and IBH Publishing Co., 1977.</li> <li>5. S.C. SHARMA, Industrial Safety and Health Management, Khanna Book Publishing Co. (P) Ltd., Delhi (ISBN: 978-93-86173-188)</li> <li>5. NADKARNI, LAKSHMI, Sociology of Industrial Worker, Rawat, Jaipur, 1998.</li> <li>6. BHOWMICK SHARIT, Industry, Labour and Society, Orient, 2012.</li> <li>7. RICHARD BROWN, JOHN CHILD, AND S R PARKER, The Sociology of Industry 1st Edition, Routledge, 2015.</li> </ol>			

<b>RAS601 INDUSTRIAL MANAGEMENT</b>		<b>L-T-P: 3-0-0</b>
<b>Unit</b>	<b>Topic</b>	<b>Proposed Lecture</b>
<b>I</b>	Introduction: Concept and scope of Industrial Management. Productivity: Definition, measurement, productivity index, types of production system, Industrial Ownership.	<b>06</b>
<b>II</b>	Functions of Management, Taylor's Scientific Management Theory, Fayol's Principles of Management, Social responsibilities of Management, Introduction to Human resources management: Nature of HRM, functions and importance of HRM.	<b>06</b>
<b>III</b>	<b>Work Study:</b> Introduction, definition, objectives, steps in work study, Method study: definition, objectives, steps of method study, Work Measurement: purpose, types of study — stop watch methods — steps — allowances — standard time calculations — work sampling, Production Planning and Control Inventory Control: Inventory, Cost, Models of inventory control: EOQ, ABC, VED	<b>06</b>
<b>IV</b>	Quality Control: statistical quality control, Control charts for variables and attributes, Acceptance Sampling- Single sampling- Double sampling plans, Introduction to TQM.	<b>06</b>
<b>V</b>	<b>Project Management:</b> Project network analysis, CPM, PERT and Project crashing and resource Leveling	<b>06</b>
<b>References:</b> 1. Engineering Management (Industrial Engineering & Management)/ S.C. Sharma & T.R. Banga, Khanna Book Publishing Co. (P) Ltd., Delhi (ISBN: 978-93-86173-072) 2. Industrial Engineering and Management/ P. Khanna, Dhanpatrai publications Ltd. 3. Production & Operation Management /PaneerSelvam /PHI. 4. Industrial Engineering Management/NVS Raju/Cengage Learning. 5. Industrial Engineering Management I RaviShankar/ Galgotia.		

<b>RUC501 /RUC601</b>		<b>CYBER SECURITY</b>	<b>L-T-P: 3-0-0</b>
<b>Unit</b>	<b>Topic</b>	<b>Proposed Lecture</b>	
<b>I</b>	<b>Introduction-</b> Introduction to Information Systems, Types of Information Systems, Development of Information Systems, Introduction to Information Security, Need for Information Security, Threats to Information Systems, Information Assurance, Cyber Security, and Security Risk Analysis.	<b>08</b>	
<b>II</b>	<b>Application Security-</b> (Database, E-mail and Internet), Data Security Considerations-Backups, Archival Storage and Disposal of Data, Security Technology-Firewall and VPNs, Intrusion Detection, Access Control. Security Threats -Viruses, Worms, Trojan Horse, Bombs, Trapdoors, Spoofs, E-mail Viruses, Macro Viruses, Malicious Software, Network and Denial of Services Attack, Security Threats to E-Commerce- Electronic Payment System, e- Cash, Credit/Debit Cards. Digital Signature, Public Key Cryptography	<b>08</b>	
<b>III</b>	<b>Developing Secure Information Systems-</b> Application Development Security, Information Security Governance & Risk Management, Security Architecture & Design Security Issues in Hardware, Data Storage & Downloadable Devices, Physical Security of IT Assets, Access Control, CCTV and Intrusion Detection Systems, Backup Security Measures.	<b>08</b>	
<b>IV</b>	<b>Security Policies-</b> Development of Policies, WWW Policies, Email Security Policies, Policy Review Process-Corporate Policies-Sample Security Policies, Publishing and Notification Requirement of the Policies. <b>Evolving Technology Security</b> – Mobile, Cloud, Outsourcing, SCM.	<b>08</b>	
<b>V</b>	<b>Information Security Standards-</b> ISO, IT Act, Copyright Act, Patent Law, IPR. Cyber Laws in India; IT Act 2000 Provisions, Intellectual Property Law: Copy Right Law, Software License, Semiconductor Law and Patent Law. <b>Case Study</b> – Corporate Security	<b>08</b>	
<b>References:</b>			
<ol style="list-style-type: none"> <li>1. Charles P. Pfleeger, Shari Lawerance Pfleeger, “Analysing Computer Security”, Pearson Education India.</li> <li>2. V.K.Pachghare, “Cryptography and information Security”, PHI Learning Private Limited, Delhi India.</li> <li>3. Sarika Gupta &amp; Gaurav Gupta, Information Security and Cyber Laws, Khanna Publishing House</li> <li>4. Anshul Kaushik, Cyber Security, Khanna Publishing House</li> <li>5. Dr.Surya Prakash Tripathi, Ritendra Goyal, Praveen Kumar Shukla ,”Introduction to Information Security and Cyber Law” Willey Dreamtech Press.</li> <li>6. Michael E.Whitman and Herbert J Mattord "Principle of Information Security" Cengage</li> <li>7. Mike Chapple and David Seidl "Cyberwarfare: Information operations in a connected world" Jones &amp; Bartlett Learning</li> <li>8. Schou, Shoemaker, “Information Assurance for the Enterprise”, Tata McGraw Hill.</li> <li>9. CHANDER, HARISH,” Cyber Laws And It Protection ” , PHI Learning Private Limited ,Delhi</li> <li>10. V.K. Jain, Cryptography and Network Security, Khanna Publishing House, Delhi</li> </ol>			

**DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY  
LUCKNOW**



**Evaluation Scheme & Syllabus  
For**

**B.Tech. Fourth Year  
(Biotechnology)**

**On  
Choice Based Credit System  
(Effective from the Session: 2019-20)**

# DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY LUCKNOW

## Study and Evaluation Scheme B.TECH. BIO-TECHNOLOGY (Effective from the session: 2019-20)

4<sup>th</sup> Year, 7<sup>th</sup> Semester

S. No.	Subject Code	Subject Name	Teaching Deptt.	L-T-P	Th/Lab Marks	Sessional		Total	Credit
						Test	Assig/Att		
1		Open Elective Course-I	Other Department	3-0-0	70	20	10	100	3
2	RBT071-074	Departmental Elective-III	Core Department	3-0-0	70	20	10	100	3
3	RBT075-078	Departmental Elective-IV	Core Department	3-1-0	70	20	10	100	4
4	RBT701	Environmental Biotechnology	Core Department	3-0-0	70	20	10	100	3
5	RBT702	Bioseperation & Down Stream Processing	Core Department	3-1-0	70	20	10	100	4
6	RBT751	Environmental Biotechnology Lab	Core Departmen	0-0-2	50		50	100	1
7	RBT752	Bioseperation & Down Stream Processing Lab	Core Department	0-0-2	50		50	100	1
8	RBT753	Industrial Training	Core Department					100	2
9	RBT754	Project-I	Core Department					200	3
	<b>Total</b>							<b>1000</b>	<b>24</b>

### Departmental Elective-III

RBT071: Genomics and Proteomics

RBT072: Quality Control & Regulatory Affairs

RBT073: Clinical Trials & Management

RBT074: Bioprocess Economics & Project Management

### Departmental Elective-IV

RBT075: Biosafety, Bioethics, IPR & Patents

RBT076: Agriculture Biotechnology

RBT077: Biomaterials

RBT078: Applications of Natural Products

## **RBT701: Environmental Biotechnology**

<b>L</b>	<b>T</b>	<b>P</b>
<b>3</b>	<b>0</b>	<b>0</b>

### **Unit I**

[8]

Environmental pollution: An overview, Land, water, air, and noise, Marine (introduction, sources, effects and measurements). Thermal Pollution, Nuclear and Radiation Pollution, Type of Radiation, Radioactivity in nature, Decay chains, Toxic Hydrocarbon, Radioactive waste, Genetic Consequences.

### **Unit II**

[8]

Biological waste treatments and biofuel production. Microbiology of waste water treatments Methanogenesis: methanogenic, acetogenic, and fermentative bacteria – anaerobic and aerobic digestion processes and conditions. Minimal national standards for waste disposal.

### **Unit III**

[8]

Principles and design aspects of various waste treatments methods, with advanced bioreactor configuration: activated sludge process, trickling filter, fluidized expanded bed reactor, upflow anaerobic sludge blanket reactor, contact process, fixed / packed bed reactor, hybrid reactor, sequential batch reactor.

### **Unit IV**

[8]

Kinetic models for biological waste treatment: bioconversion of agricultural and other highly organic waste materials into gainfully utilizable products – biogas, H<sub>2</sub>, celluloses and food and feed stocks. Economical and social aspects of waste treatment.

### **Unit V**

[8]

Bioremediation & Biomineralization: land, water, Contaminated Soil, industries, organic contaminants, heavy metals. Bioconversion of cellulose, Hemicelluloses, Lignin (lignocelluloses), Bioleaching of ores, Recovery of metals.

### **Recommended Books:**

1. Waste Water Engineering- Metcalf & Fuddy, 3rd ed.
2. Environmental Processes I-III, J. Winter, 2nd ed., Wiley Publications
3. Introduction to Waste Water Treatment- R. S. Ramalho, Academic Press.
4. Environmental Studies- Dwivedi & Mishra, Ed. 2007.
5. Environmental Biotechnology, B.C. Bhattacharya & Ritu Banerjee, Oxford Press, 2007.
6. Essentials of Ecology & Environmental Science, S.V.S. Rana, Prentic-Hall India, 2006.
7. Perspectives in Environmental Studies, Anubha Kaushik & C P Kaushik, New Age International Publishers, 2004.
8. Agarwal S.K. (1998), Environmental Biotechnology, APH Publishing Corporation, New Delhi.
9. Environmental Sciences – Purohit, Shammi & Agrawal, Student Edition 2004.

## **RBT702: Bioseparation & Down Stream Processing**

<b>L</b>	<b>T</b>	<b>P</b>
<b>3</b>	<b>1</b>	<b>0</b>

### **UNIT I - INTRODUCTION TO BIOSEPARATION PROCESS**

**(8)**

Role and importance of bioseparation in biotechnological processes: RIPP scheme, Problems and requirements of bioproducts purification - Properties of Biomolecules - Characteristics of fermentation broth - Biological activity, Analysis of purity-Process economics: Capital and operating cost analysis.

### **UNIT II - REMOVAL OF INSOLUBLES**

**(8)**

Cell disruption methods for intracellular products: Physical, chemical and mechanical - Removal of insolubles: Biomass and particulate debris separation techniques - flocculation - sedimentation - centrifugation and filtration methods.

### **UNIT III - ISOLATION OF PRODUCTS**

**(8)**

Adsorption: Principles - Langumir - Freundlich isotherms - Extraction: Basics- Batch and continuous, aqueous two-phase extraction - supercritical extraction - *in situ* product removal - Precipitation: Methods of precipitation with salts - organic solvents and polymers - Membrane based separations: Micro and ultra filtration - theory - design and configuration of membrane separation equipments and its applications.

### **UNIT IV - PURIFICATION OF BIOPRODUCT**

**(8)**

Basic principles of Chromatographic separations: GC-HPLC-gel permeation-ion-exchange-affinity- reverse phase and hydrophobic interaction chromatography-Electrophoretic separation techniques: capillary - isoelectric focusing-2D gel electrophoresis - Hybrid separation technologies: GC-MS and LC-MS.

### **UNIT V - PRODUCT POLISHING**

**(8)**

Crystallization: Principles-Nucleation-Crystal growth-Kinetics-Batch crystallizers: Scale-up and design, Drying: Principles-Water in biological solids- Heat and mass transfer-Drying equipments: description and operation-Vacuum shelf - rotary dryer-Freeze dryer-Spray dryer. Biomolecules of Commercial importance Ethanol, citric acid, lysine, steroids, penicillin, dextran, trehalose, subtilisin, chymosin, vitamin B12, hepatitis B vaccine, insulin, erythropoietin, monoclonal antibodies.

### **TEXT BOOKS**

1. Roger G. Harrison, Paul Todd, Scott R. Rudge, Demetri P. Petrides, "*Bio separation Science and Engineering*" Oxford University press, 2003.

2. Belter PA and Cussler E, "*Bioseparations*", Wiley, 1985.
3. Protein: Biochemistry and Biotechnology by Gary Walsh (2002 John Wiley & Sons Ltd.)
4. Process Biotechnology Fundamentals by S.N. Mukhopadhyay (2001). Viva Books Private Limited.
5. Schuler & Kargi, Bio-process Engg. PHI
6. Keith Wilson and John Walker, Practical Biochemistry—Principles and Techniques, Cambridge, 5th Ed.2000
7. Coulson & Richardson's Chemical Engineering – Volume 3 (Chemical and Biochemical Reactors and process controls) ed. Richardson, J.F., Peacock, D.G., First Indian ed. Asian Books Pvt. Ltd. 1998.
8. Bailey & oils, Biochemical Engg. Fundamentals, McGraw-Hill, 1990
9. Geankoplis, C.J. Transport Processes and Unit Operations Prentice Hall of (I) 3rd ed. 1997.
10. Mukhopadhyay, S.N. Process Biotechnology Fundamentals, Viva Books Pvt. Ltd. 2001.
11. Muni & Cheryan, Handbook of Ultrafiltration

## REFERENCES

1. Raja Ghosh, "*Principles of Bioseparations Engineering*", World Scientific Publishing, 2006.
2. Ladisch.M.R, "*Bioseparation Engineering: Principles, Practice and Economics*", John Wiley & sons, New York, 2001.
3. Asenjo.J.M, "*Separation processes in Biotechnology*" Marcel Dekker Inc.1993.

## RBT071: Genomics and Proteomics

<b>L</b>	<b>T</b>	<b>P</b>
<b>3</b>	<b>0</b>	<b>0</b>

### Unit I

**[10]**

Introduction Structural organization of genome in Prokaryotes and Eukaryotes; Organelle DNA-mitochondrial, chloroplast; DNA sequencing-principles and translation to large scale projects; Recognition of coding and non-coding sequences and gene annotation; Tools for genome analysis-RFLP, DNA fingerprinting, RAPD, PCR, Linkage and Pedigree analysis-physical and genetic mapping.

### Unit II

**[8]**

Genome sequencing projects Microbes, plants and animals; Accessing and retrieving genome project information from web; Comparative genomics, Identification and classification using molecular markers-16S rRNA typing/sequencing, EST's and SNP's.

### Unit III

**[8]**

Proteomics Protein analysis (includes measurement of concentration, amino-acid composition, N-terminal sequencing); 2-D electrophoresis of proteins; Microscale solution isoelectricfocusing;

Peptide fingerprinting; LC/MS-MS for identification of proteins and modified proteins; MALDI-TOF; SAGE and Differential display proteomics, Protein-protein interactions, Yeast two hybrid system.

**Unit IV** [6]

Pharmacogenetics High throughput screening in genome for drug discovery-identification of gene targets, Pharmacogenetics and drug development

**Unit V** [8]

Functional genomics and proteomics Analysis of microarray data; Protein and peptide microarray-based technology; PCR-directed protein in situ arrays; Structural proteomics

**Texts/References :**

1. Voet D, Voet JG & Pratt CW, Fundamentals of Biochemistry, 2nd ed. Wiley 2006
2. Brown TA, Genomes, 3rd ed. Garland Science 2006
3. Campbell AM & Heyer LJ, Discovering Genomics, Proteomics and Bioinformatics, 2nd ed. Benjamin Cummings 2007
4. Primrose S & Twyman R, Principles of Gene Manipulation and Genomics, 7th ed, Blackwell [2006].
5. Glick BR & Pasternak JJ, Molecular Biotechnology, 3rd ed, ASM Press [1998]

**RBT072: Quality Control & Regulatory Affairs**

<b>L</b>	<b>T</b>	<b>P</b>
<b>3</b>	<b>0</b>	<b>0</b>

**Unit I** [8]

Concept and evolution of quality control and quality assurance. Quality control laboratory responsibilities: GLP protocols on non-clinical testing control on animal house, data generation, integration and storage, standard test procedure, retention of sample records. CPCSEA guidelines.

**Unit II** [8]

Quality review and batch release document of finished products, annual product quality review and parametric release, Audits, quality audits of manufacturing processes and facilities, audits of quality control.

**Unit III** [8]

Good documentation practices, root cause analysis, corrective action preventive action (CAPA), out of specifications (OOS) and out of trend (OOT), Clinical studies- ICH GCP (E6) guidelines, post marketing surveillance, Pharmacovigilance

**Unit IV****[8]**

BABE (bioavailability and bioequivalence) studies, Concepts and management of contract manufacturing guidelines, Statistical Tools for Quality Control and Precision, Tools of Problem Solving and Continuous Improvement

**Unit V****[8]**

Introduction, scope and importance of IPR, Concept of trade mark, copyright and patents Product registration guidelines – CDSCO, USFDA, Concept of ISO 9001:2008, 14000, OSHAS guidelines, Quality Strategy for Indian Industry, Brief concept of IND, NDA, ANDA, SNDA and PAT.

**References:**

1. Sharp J. Good Pharmaceutical Manufacturing Practice: Rationale and Compliance. CRC Press; 2005.
2. Chow SC. Encyclopedia of Biopharmaceutical Statistics. Marcel Dekker; 2003. Page 6 of 16
3. McCormick K. Quality (Pharmaceutical Engineering Series). Butterworth-Heinemann; 2002.
4. Gad SC. Pharmaceutical Manufacturing Handbook: Production and Processes. John Wiley & Sons; 2008.
5. Willig SH, Stoker JR. Good manufacturing practices for pharmaceuticals: a plan for total quality control. Marcel Dekker; 1997.
6. Signore AA, Jacobs T. Good Design Practices for GMP Pharmaceutical Facilities. Taylor & Francis Group; 2005.
7. Sarker DK. Quality Systems and Controls for Pharmaceuticals. John Wiley & Sons; 2008.
8. Haider SI. Pharmaceutical Master Validation Plan: The Ultimate Guide to FDA, GMP, and GLP Compliance. St. Lucie Press; 2002.
9. Steinborn L. GMP/ISO Quality Audit Manual for Healthcare Manufacturers and Their Suppliers, Sixth Edition, (Volume 1 - With Checklists and Software Package). Taylor & Francis; 2003.
10. Kolman J, Meng P, Scott G. Good Clinical Practice: Standard Operating Procedures for Clinical Researchers. Wiley; 1998.

**RBT073: Clinical Trials & Management**

<b>L</b>	<b>T</b>	<b>P</b>
<b>3</b>	<b>0</b>	<b>0</b>

**Unit-I****[8]**

General Introduction - Good Clinical Practices, Basics Of Drug Development - Basic Principles of Drug discovery & Development, Stages of Drug Discovery. Research for a new drug. Preclinical Research, Pharmacokinetics & Drug Disposition

**Unit-II****[8]**

Ethics In Clinical Research - Ethical issues in the conduct of clinical trials in India, Readiness of ethics committees, Independence of ethics committees, Training for ethics committee members. Informed consent process.

**Unit-III****[8]**

Regulatory Affairs In Clinical Research - Roles & Responsibilities, Pharmacovigilance researching, assessing and evaluating information from healthcare providers and patients. Pharmacovigilance is particularly concerned with adverse drug reactions. Adequacy of regulations to safeguard the clinical trial participants.

**Unit-IV****[8]**

Essential Documents & Regulatory Submission, Compliance And Audits - preparation, production and quality control of regulatory documents, creating editorial timelines and work flow specifications, scheduling and tracking documents, writing and proofreading. Development and updates on specifications for the design, tracking of regulatory documents and artwork used in regulatory documents.

**Unit-V****[8]**

Clinical Trial Monitoring - Fundamentals of Clinical Monitoring, the processes and procedures of monitoring a clinical trial, Clinical, Pharmacological (including pharmacodynamics and pharmacokinetic) or adverse Effects with the objective of determining safety and efficacy of the new drug. Clinical Data Management And Biostatistics – establishment of protocol-specific data review and entry guidelines to document data validation and formatting procedures.

**RBT074: Bioprocess Economics and Project Management**

<b>L</b>	<b>T</b>	<b>P</b>
<b>3</b>	<b>0</b>	<b>0</b>

**UNIT I****[8]**

Introduction to statistical process control and capability analysis: Chance and assignable cause of quality variation, Statistical basis of process monitoring: control chart, choice of control charts, analysis of control chart, variable of control charts, X bar and R chart, Attribute control chart, Determining process and measurement capability

**UNIT II****[8]**

DOE Approach to Medium Optimization: - traditional (linear) approach (OFAT) and multi-dimensional approach (Box-Bhenken Design, central composite design, Plackett-Burman Design, Downhill Method, Full factorial, Fractional factorial,);

**UNIT III****[8]**

Introduction: Meaning, Nature and Scope of Economics, Meaning of Science, Engineering and Technology Managerial Economics and its scope in engineering perspective. Basic Concepts Demand Analysis, Law of Demand, Determinates of Demand, Elasticity of Demand-Price, and Income and cross Elasticity .Uses of concept of elasticity of demand in managerial decision

**UNIT IV****[8]**

Demand forecasting: Meaning, significance and methods of demand forecasting, production function, Laws of returns to scale & Law of diminishing returns scale. An overview of Short and Long run cost curves – fixed cost, variable cost, average cost, marginal cost, Opportunity cost.

## **UNIT V**

[8]

Introduction: Concept, Development, application and scope of Industrial Management. Management Function: Principles Production requirements. Productivity: Definition, measurement, productivity index, types of production system, Industrial of Management- Management Tools – time and motion study, work simplification- process charts and flow diagrams, Production Planning, Specification of Ownership.

### **Text/Reference Books:**

1. Douglas C Montgomery: Statistical Quality Control
2. Managerial Economics for Engineering: Prof. D.N. Kakkar
3. T.R. Banga: Industrial Engineering and Management
4. Managerial Economics: Maheshwari.
5. Khanna O.P.: Industrial Engineering

## **Departmental Elective-IV**

### **RBT075: BIOSAFETY, BIOETHICS, IPR & PATENTS**

**L T P**  
**3 1 0**

Unit 1: BIOSAFETY-REGULATORY FRAMEWORK FOR GMOS IN INDIA  
Regulatory framework in India governing GMOs-Recombinant DNA Advisory Committee (RDAC), Institutional Biosafety Committee (IBC), Review Committee on Genetic Manipulation, Genetic Engineering Approval Committee (GEAC), State Biosafety Coordination Committee (SBCC), District Level Committee (DLC). Recombinant DNA Guidelines (1990), Revised Guidelines for Research in Transgenic Plants (1998), Seed Policy (2002), Prevention Food Adulteration Act (1955), The Food Safety and Standards Bill (2005), Plant Quarantine Order (2003), Regulation for Import of GM Products Under Foreign Trade Policy (2006-2007), National Environment Policy (2006). Rules for the manufacture, use/import/export and storage of hazardous microorganisms/genetically engineered organisms or cells (Ministry of Environment and Forests Notification, (1989).

Unit 2: BIOSAFETY-REGULATORY FRAMEWORK FOR GMOS AT INTERNATIONAL LEVEL  
Convention of Biological Diversity (1992) – Cartagena Protocol on Biosafety – Objectives and salient features of Cartagena Protocol – Advanced Information Agreement (AIA) procedure – procedures for GMOs intended for direct use-risk assessment-risk management-handling, transport, packaging and identification of GMOs- Biosafety Clearing House-unintentional transboundary

movement of GMOs-Benefits of becoming a party to the Cartagena Protocol- status of implementation in India.

Unit3: BIOETHICS Distinction among various forms of IPR, ,Prior art for a patent, Patenting live microorganism, Human Genome project and ethical issues, Animal cloning, human cloning and their ethical issues, Experimenting on animals. Public education of producing transgenic organism, legal and socioeconomic impacts of biotechnology, testing drugs on human volunteers, Hazardous materials used in biotechnology, their handling and disposal.

Unit 4: INTELLECTUAL PROPERTY RIGHTS Concept of property, rights, duties and Jurisprudential definition, Introduction to patent, copy right, trademarks, Design, geographical indication. History and evolution of IPR, Economic importance of IPR, Indian patent act 1970 (amendment 2000), Distinction among various forms of IPR, invention step, biopiracy and bioprospecting- Appropriate case studies. Infringement/violation of patent, remedies against infringement (civil, criminal, administrative)

Unit 5: PATENTS AND PATENT LAWS Plant and Animal growers rights patents trade secrets, and plant genetic recourses GATT and TRIPS, Dunkels Draft Patenting of biological materials, Current Issues of Patents for higher animal and higher plants, patenting of transgenic organisms, isolated genes and DNA sequences.

#### **REFERENCES:**

1. Beier, F.K., Crespi, R.S. and Straus, T. Biotechnology and Patent protection-Oxford and IBH Publishing Co. New Delhi.
2. Intellectual property rights and Bio-Technology (Biosafety and Bioethics), Anupam Singh, Ashwani Singh, NPH, New Delhi
3. Sasson A, Biotechnologies and Development, UNESCO Publications.
4. Singh K, Intellectual Property rights on Biotechnology, BCIL, New Delhi
5. Regulatory Framework for GMOs in India (2006) Ministry of Environment and Forest, Government of India, New Delhi
6. Cartagena Protocol on Biosafety (2006) Ministry of Environment and Forest, Government of India, New Delhi

**RBT076: AGRICULTURE BIOTECHNOLOGY****L T P  
3 1 0**

UNIT I :Agriculture and Agricultural Biotechnology, Clonal Germplasm: Micro propagation, In vitro production of pathogen and contaminant free plants . (6)

UNIT II Biotechnology- Methods of Crop Improvement: Genetic Engineering of Crop Plants, Transgenic Plants, Molecular Markers, QTL Mapping. (6)

UNIT III : Microbes in Agriculture and Food: Applied Microbiology in the future of mankind, moving frontiers of applied microbiology, microbial enzymes and their applications in food processing and agrochemical industries, agro-waste utilization, biodegradable polymers and their applications, microbial polysaccharides; Production and utilization of essential amino-acids, chemicals from micro-algae. (12)

UNIT IV : Metabolite Production: Production of Secondary Metabolites, Production of foreign compounds in transgenic plant, Achievements and recent developments of genetic engineering in agriculture. (8)

UNIT V : Biofertilizers and Bioremediation: Microbial Biopesticides, Biofungicides, Herbicides, and Agricultural antibiotic Biotechnology in Agriculture: Ethical Aspects and Public Acceptance, Animal farming. (8)

**Reference Books:**

1. Biotechnology by B.D.Singh, Kalyani Publication
2. Biotechnology – Fundamentals and applications by S.S.Purohit, Student Edition
3. Agricultural Biotechnology-Arie Altman, CRC Press
4. Biotechnology- An Introduction by Susan R. Barnum, Vikas Publishing House

**RBT077: Biomaterials****L T P  
3 1 0**

Unit I: Introduction and overview of biomaterials Definition of biomaterials – biologically derived materials or materials compatible with biology. Biomaterials: Classification of bio-materials (based on tissue response), Tissue engineering, Biosensor. (8)

Unit II: Interactions of materials Interactions of materials with human body, bio-compatibility of materials, metals (stainless steels, cobalt-chromium alloys, titanium based alloys, nitinol), Ceramics (carbons, alumina, resorbable ceramics, surface reactive

ceramics), bio polymers(collagens, elastin, mucopolysachharides, cellulose and derivatives, chitin and other polysaccharides and composites as biomaterials. (8)

Unit III: Tissue Grafts and Soft Tissue applications Tissue graft and rejection process, skin grafts, connective tissue grafts, blood, fluid transfer implants, urological practise, microencapsulation of live animal cells, bulk space fillers, percutaneous devices. Materials for hard tissue replacement: orthopaedic implants, dental implants. (8)

Unit IV: Cardiovascular Implants and Ophthalmology Cardiovascular implants (blood clotting, blood rheology, blood vessels, heart, aorta and valves, lungs),cardiac pacemakers, Ophthalmology, materials for artificial organs transplant and extracorporeal device, Orthopaedic implants (joint replacement, knee joint replacement, temporary fixation devices) . (8)

Unit V: Legal Issues Recent developments in biomaterials, legal issues related to development of biomaterials. (8)

**Text/Reference Books:**

- 1) Biomaterials: An Introduction by Park J.B. and Lakes R.S., Plenum Press, New York.
- 2) Biomaterials, Medical Devices & Tissue Engineering: An Integrated Approach by Silver F.H., Chapman and Hall publication.
- 3) Biomaterials by Bhat Sujata V., Narosa PublishingHouse.
- 4) Biomaterials science: an introduction to materials in medicine by Buddy D. Ratner., Elsevier Academic Press.
- 5) Biomaterials: A Tantalus Experience by Jozef A. Helsen., Yannis Missirlis Springer.
- 6) Biomaterials by Temenoff Johnna S., Dorling Kindersley India Pvt Ltd.

**RBT078: Applications of Natural Products****L T P****3 1 0**

Unit-I :Sources of crude drug: Biological, marine, Mineral and plant tissue culture as source of natural products. Various methods of extraction and isolation of phytopharmaceuticals namely infusion, decoction, maceration, percolation, hot continuous extraction, successive solvent extraction, supercritical fluid extraction, steam distillation, Counter-current Extraction, Ultrasound Extraction (Sonication). Parameters for selection of suitable extraction process. (8)

Unit-II: Phytochemical Screening: Screening of alkaloids, saponins, cardenolides and bufadienolides, flavonoids and leucoanthocyanidins, tannins and polyphenols, anthraquinones, cynogenetic glycosides, amino acids in plant extracts. Important therapeutic classes: antimicrobial, antidiabetics, hepatoprotectives, immunomodulators, anti-cancer. (8)

Unit-III : Herbal cosmetics: Importance of herbals as shampoos (soapnut), conditioners and hair darkeners, (amla, henna, hibiscus, tea), skin care (aloe, turmeric, lemon peel, vetiver); Colouring and Flavouring agents from plants; Utilization of aromatic plants and derived products with special reference to sandalwood oil, mentha oil, lemon grass oil, vetiver oil, geranium oil and eucalyptus oil. (8)

Unit-IV : Nutraceuticals and Health Foods: Classification of Nutraceuticals, Health foods: Source, Chemical constituents, uses, actions and commercial preparations of, following health foods, Alfalfa, Bran, Angelica, Chamomile, Corn oil, Fenugreek, Feverfew, Garlic, Ginseng, Ginkgo, Honey, Hops, Safflower oil, Soyabean Oil, Turmeric. Concept and examples of Adaptogens .(10)

Unit-V : Quality control of herbal drugs as per WHO, AYUSH and Pharmacopoeial guidelines-Extractive values, ash values. Determination of heavy metals, insecticides, pesticides and microbial load in herbal preparations. (6)

**Text / Reference Books:**

1. Manual K. Lindsey, Plant Tissue Culture, Springer U.K. Wagner.
2. Wagner and Blatt, Plant Drug analysis, Springer U.K.
3. A.R.Kashi, Industrial Pharmacognosy, Universities press
4. S.S.Agrawal, Herbal drug technology, Universities press
5. Quality Standards of Indian Medicinal Plants, Vol 10, (ICMR), New Delhi, 2012.
6. Indian Herbal Pharmacopoeia, K. M. Varghese Co.Bombay.
7. Craker L., Herbs, Spices And Medicinal Plants, CBS Publishers

8. N.R. Krishnaswamy Chemistry of Natural Products: A Unified Approach, University Press (India) Ltd., Orient Longman Limited, Hyderabad, 1999.

**RBT751: Environmental Biotechnology Lab**

**L      T      P**  
**0      0      2**

1. Study of laboratory equipments used in Environmental Biotechnology lab.
2. To perform the waste Water Sampling by Random Sampling Method
3. Preparation of stocks solutions.
4. Estimation of Biological Oxygen Demand (BOD) of waste water.
5. Estimation of Chemical Oxygen Demand (COD) of waste water.
6. Estimation of Dissolved Oxygen
7. Estimation of Total Hardness in given Water Sample.
8. Estimation of Total dissolved and suspended solid in waste water
9. Alkalinity & Acidity of waste water
10. Estimation of optimum dosage of ferric chloride for removal of suspended matter
11. Nitrogen estimation by Kjeldahl method,
12. To determine the amount of total Coliform in the water sample

**RBT752: Bioseparation & Down Stream Processing Lab**

**L      T      P**  
**0      0      2**

1. Characteristics of Bioproducts: Flocculation and conditioning of broth
2. Mechanical separation: Filtration and Centrifugation
3. Cell disruption
4. Membrane based separation
5. Protein precipitation and its separation: Aqueous two phase extraction, Ultra filtration and Adsorption
6. Chromatography separation based on size, charge, hydrophobic interaction

7. Gel analysis/ assay for dialysed product

8. Product crystallization and drying

**DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW**

**Study and Evaluation Scheme  
B.TECH. BIO-TECHNOLOGY  
(Effective from the session: 2019-20)**

**4<sup>th</sup> Year, 8<sup>th</sup> Semester**

S. No.	Subject Code	Subject Name	Teaching Deptt.	L-T-P	Th/Lab Marks	Sessional		Total	Credit
						Test	Assig./Att.		
1		Open Elective Course-II	Other Department	3-0-0	70	20	10	100	3
2	RBT081-84	Departmental Elective-V	Core Department	3-1-0	70	20	10	100	4
3	RBT085-088	Departmental Elective-VI	Core Department	3-0-0	70	20	10	100	3
4	RBT851	Seminar	Core Department	0-0-3			100	100	2
5	RBT852	Project-II	Core Department	0-0-12	350		250	600	12
	<b>Total</b>							<b>1000</b>	<b>24</b>

**Departmental Elective-V**

RBT081: Experimental Biotechnology (NPTEL)

RBT082: Tissue Engineering (NPTEL)

RBT083: Introductory mathematical models for biologists (NPTEL)

RBT084: Database Design (NPTEL)

**Departmental Elective-VI**

RBT085: Biostatistics & design of experiments (NPTEL)

RBT086: Integrated waste management for smart cities (NPTEL)

RBT087: Industrial Biotechnology (NPTEL)


RBT088: Computer aided drug design (NPTEL)

## Departmental Elective-V

### RBT081: Experimental Biotechnology (NPTEL)

NPTEL Syllabus																										
<h2>Experimental Biotechnology - Web course</h2>																										
<p><b>COURSE OUTLINE</b></p> <p>Good lab practices and precautions, Spectroscopy: Recording UV/Visible absorption spectra for biomacromolecules and quantification; Fluorescence Spectroscopy: monitor equilibrium unfolding of a protein using tryptophan fluorescence; CD spectroscopy, IR spectroscopy. Chromatography: size exclusion chromatography of a crude mixture of proteins using standard matrix and dyes; HPLC, Fluorescence Microscopy: localization of antigen in cells; scanning and transmission electron microscopy. Atomic force microscope. Generation of polyclonal and monoclonal antibodies, Immuno-assays to detect and quantify antigens. Electrophoresis: electrophoresis of protein and nucleic acid. Characterization and quantification of proteins and nucleic acids. Molecular cloning techniques: Preparation and Transformation of competent cells, Small scale isolation of recombinant plasmid; Analysis of the recombinant plasmid using Restriction Endonucleases.</p>																										
<p><b>COURSE DETAIL</b></p> <table border="1"> <thead> <tr> <th>Module*</th> <th>Topics and Contents</th> <th>No of Lectures</th> </tr> </thead> <tbody> <tr> <td>1. Introduction</td> <td>Introduction, Concept of buffers.</td> <td>3</td> </tr> <tr> <td>2. Spectroscopic experiments</td> <td>Spectroscopic techniques: UV-Visible spectroscopy, Fluorescence spectroscopy, CD spectroscopy, IR spectroscopy. Protein estimation 1, 2, DNA estimation, unfolding, Protein unfolding, CD, IR</td> <td>10</td> </tr> <tr> <td>3. electrophoretic experiments</td> <td>Electrophoresis; Principle, performing electrophoresis techniques, application of electrophoresis in analyzing macromolecules.</td> <td>7</td> </tr> <tr> <td>4. Chromatographic experiments</td> <td>Chromatographic techniques; Principles, Column chromatography, HPLC</td> <td>5</td> </tr> <tr> <td>5. Immunological experiments</td> <td>Antibody generation and purification, immuno-assays to detect and quantify antigens.</td> <td>4</td> </tr> <tr> <td>6. microscopic experiments</td> <td>Light Microscopy; Fluorescence microscopy, Atomic force microscope, Electron microscope, Scanning electron microscopy, Transmission Electron microscope.</td> <td>7</td> </tr> <tr> <td>7. Molecular cloning</td> <td>Preparation and transformation of competent cells; Small scale isolation of recombinant plasmid, Analysis of the recombinant plasmid using Restriction Endonucleases.</td> <td>4</td> </tr> </tbody> </table>			Module*	Topics and Contents	No of Lectures	1. Introduction	Introduction, Concept of buffers.	3	2. Spectroscopic experiments	Spectroscopic techniques: UV-Visible spectroscopy, Fluorescence spectroscopy, CD spectroscopy, IR spectroscopy. Protein estimation 1, 2, DNA estimation, unfolding, Protein unfolding, CD, IR	10	3. electrophoretic experiments	Electrophoresis; Principle, performing electrophoresis techniques, application of electrophoresis in analyzing macromolecules.	7	4. Chromatographic experiments	Chromatographic techniques; Principles, Column chromatography, HPLC	5	5. Immunological experiments	Antibody generation and purification, immuno-assays to detect and quantify antigens.	4	6. microscopic experiments	Light Microscopy; Fluorescence microscopy, Atomic force microscope, Electron microscope, Scanning electron microscopy, Transmission Electron microscope.	7	7. Molecular cloning	Preparation and transformation of competent cells; Small scale isolation of recombinant plasmid, Analysis of the recombinant plasmid using Restriction Endonucleases.	4
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<p>*Mid course examination after module 3 and finals after the completion of module 6.</p> <p>**Numbers of lectures are tentatively fixed.</p>																										
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. A. J. Nifita and D. P. Bailou, <i>Fundamental Laboratory Approaches for Biochemistry and Biotechnology</i>, Wiley; 2nd Edition, 1998.</li> <li>2. J. Sambrook and D. W. Russell, <i>Molecular Cloning: A Laboratory Manual</i>, Cold Spring Harbor Laboratory Press, 3rd Edition, 2001.</li> <li>3. Live Cell Imaging: A Laboratory Manual R. D. Goldman, J. R. Swedlow and D. L. Spector Cold Spring Harbor Laboratory Press; 2nd edition, 2009</li> <li>4. Basic Methods in Microscopy, Protocols and concepts from cells: A Laboratory Manual, D. L. Spector &amp; R. D. Goldman (Editors), Cold Spring Harbor Laboratory Press, 2006</li> <li>5. A. Manz, N. Pamme and D. Iossifidis, <i>Bioanalytical Chemistry</i>, World Scientific Publishing Company, 2004</li> <li>6. R.J. Simpson, <i>Proteins and Proteomics: A Laboratory Manual</i>, CSHL press, 2003</li> </ol>																										
<p>A joint venture by IISc and IITB, funded by MHRD, Govt of India</p>																										
<p>  <b>NPTEL</b>  <a href="http://npTEL.ac.in">http://npTEL.ac.in</a>  <b>Biotechnology</b></p>																										
<p><b>Coordinators:</b></p> <p><b>Dr. Nitin Chaudhary</b>            Department of Biotechnology/IIT Guwahati</p> <p><b>Dr. Vishal Trivedi</b>            Department of Biotechnology/IIT Guwahati</p>																										
<p><a href="http://npTEL.ac.in">http://npTEL.ac.in</a></p>																										

## RBT082: Tissue Engineering (NPTEL)

NPTEL Syllabus																													
<h3>Tissue Engineering - Web course</h3> <p><b>COURSE OUTLINE</b></p> <p>This course helps the learners to understand thoroughly the key concepts of tissue organization, remodeling and strategies for restoration of tissue function. This will enable them to design tissue regeneration and tissue injury repair strategies.</p> <p><b>COURSE DETAIL</b></p> <table border="1"> <thead> <tr> <th>Sl. No</th> <th>Course content</th> <th>Duration (in hours)</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>Introduction to tissue engineering, Cells as therapeutic Agents with examples, Cell numbers and growth rates.</td> <td>2</td> </tr> <tr> <td>2.</td> <td>Tissue organization, Tissue Components, Tissue types, Functional subunits. Tissue Dynamics, Dynamic states of tissues, Homeostasis in highly proliferic tissues and Tissue repair. Angiogenesis.</td> <td>3</td> </tr> <tr> <td>3.</td> <td>Cellular fate processes, Cell differentiation, Cell migration - underlying biochemical process.</td> <td>3</td> </tr> <tr> <td>4.</td> <td>Cell division - mitotic cell cycle, Cell death - biological description of apoptosis.</td> <td>3</td> </tr> <tr> <td>5.</td> <td>Coordination of cellular fate processes - soluble signals, types of growth factors and chemokines, sending and receiving a signal, processing a signal, integrated responses, soluble growth factor receptors, Malfunctions in soluble signaling.</td> <td>3</td> </tr> <tr> <td>6.</td> <td>Cell-extracellular matrix interactions - Binding to the ECM, Modifying the ECM, Malfunctions in ECM signaling.  Direct Cell-Cell contact - Cell junctions in tissues, malfunctions in direct cell-cell contact signaling. Response to mechanical stimuli.</td> <td>3</td> </tr> <tr> <td>7.</td> <td>Measurement of cell characteristics - cell morphology, cell number and viability, cell-fate processes, cell motility, cell function.</td> <td>2</td> </tr> <tr> <td>8.</td> <td>Cell and tissue culture - types of tissue culture, media, culture environment and maintenance of cells in vitro, cryopreservation.</td> <td>3</td> </tr> </tbody> </table>			Sl. No	Course content	Duration (in hours)	1.	Introduction to tissue engineering, Cells as therapeutic Agents with examples, Cell numbers and growth rates.	2	2.	Tissue organization, Tissue Components, Tissue types, Functional subunits. Tissue Dynamics, Dynamic states of tissues, Homeostasis in highly proliferic tissues and Tissue repair. Angiogenesis.	3	3.	Cellular fate processes, Cell differentiation, Cell migration - underlying biochemical process.	3	4.	Cell division - mitotic cell cycle, Cell death - biological description of apoptosis.	3	5.	Coordination of cellular fate processes - soluble signals, types of growth factors and chemokines, sending and receiving a signal, processing a signal, integrated responses, soluble growth factor receptors, Malfunctions in soluble signaling.	3	6.	Cell-extracellular matrix interactions - Binding to the ECM, Modifying the ECM, Malfunctions in ECM signaling.  Direct Cell-Cell contact - Cell junctions in tissues, malfunctions in direct cell-cell contact signaling. Response to mechanical stimuli.	3	7.	Measurement of cell characteristics - cell morphology, cell number and viability, cell-fate processes, cell motility, cell function.	2	8.	Cell and tissue culture - types of tissue culture, media, culture environment and maintenance of cells in vitro, cryopreservation.	3
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 <p><b>NPTEL</b> http://nptel.iitm.ac.in</p> <p><b>Biotechnology</b></p>																													
<p><b>Pre-requisites:</b></p> <ul style="list-style-type: none"> <li>• Basic Biology</li> <li>• Cell Biology</li> </ul> <p><b>Additional Reading:</b></p> <ul style="list-style-type: none"> <li>• Articles in Journals: Biomaterials, Advanced Drug Delivery Reviews.</li> </ul> <p><b>Hyperlinks:</b></p> <ul style="list-style-type: none"> <li>• <a href="http://web.mit.edu/langerlab/">http://web.mit.edu/langerlab/</a></li> <li>• <a href="http://mcu.by.virginia.edu/laurencin/index.htm">http://mcu.by.virginia.edu/laurencin/index.htm</a></li> </ul> <p><b>Coordinators:</b></p> <p><b>Dr. S. Swaminathan</b> Centre for Nanotechnology &amp; Advanced Biomaterials SASTRA University</p>																													

9.	Basis for Cell Separation, characterization of cell separation, methods of cell separation.	3
10.	Biomaterials in tissue engineering - biodegradable polymers and polymer scaffold processing.	3
11.	Growth factor delivery, Stem cells.	3
12.	Gene therapy.	1
13.	Bioreactors for Tissue Engineering.	1
14.	In vivo cell & tissue engineering case studies: Artificial skin, Artificial blood vessels.	3
15.	In vivo cell & tissue engineering case studies: Artificial pancreas, Artificial liver.	3
16.	In vivo cell & tissue engineering case studies: Regeneration of bone, muscle.	3
17.	In vivo cell & tissue engineering case studies: Nerve regeneration.	3
	<b>Total</b>	<b>45</b>

**References:**

- "Tissue Engineering", Bernhard O. Palsson, Sangeeta N. Bhatia, Pearson Prentice Hall Bioengineering.
- "Nanotechnology and Tissue engineering - The Scaffold", Cato T. Laurencin, Lakshmi S. Nair, CRC Press.

## RBT083: Introductory mathematical models for biologists (NPTEL)

**NPTEL SYLLABUS**  
NATIONAL PROGRAMME ON TECHNOLOGY ENHANCED LEARNING



### Mathematics for biologists Biotechnology

**Instructor Name:** Prof.Ranjith Padinhateeri  
**Institute:** IIT Bombay  
**Department:** Biotechnology

**About Instructor:** I am a faculty in the department of biosciences and bioengineering at IIT Bombay. My research area is computational biophysics. I do theoretical study of biological systems using methods from physics.


**Pre Requisites:** :  
**Core/Elective:** : Core  
**UG/PG:** : Both  
**Industry Support:** :

**Course Intro:** : It is an introductory mathematics course for biology students with the aim of training them to do quantitative analysis of biological systems.

#### COURSE PLAN


SL.NO	Week	Module Name
1	1	Need of mathematics. Functions: Equations as graphs and images (2D image & 3D objects)
2	2	Derivatives, meaning of derivatives, numerical computation of derivatives
3	3	Second derivative, maxima, minima, sketching functions
4	4	Integration with examples, numerical computation of integrals
5	5	Differential equations describing biological phenomena
6	6	Vectors with examples, differential equation with vector signs
7	7	Diffusion, Nernst equation, Einstein's relation
8	8	Fourier series: Fourier transform: understanding scattering experiments
9	9	Basics of statistics, mean, standard deviation, distribution function
10	10	Binomial, Poisson and Normal distributions in biology
11	11	Survey, sampling, hypothesis testing z-test, t-test
12	12	Regression, curve fitting, Conclusion

## RBT084: Database Design (NPTEL)

<b>NPTEL Syllabus</b>	
<h3>Database Design - Video course</h3>	 <p>NP-TEL</p>
<p><b>Module 1:</b> Introductory Concepts (1 session) Databases and Information Systems, An example usage context, Database system concepts and architecture.</p>	<h1>NPTEL</h1> <p><a href="http://nptel.ac.in">http://nptel.ac.in</a></p>
<p><b>Module 2:</b> Semantic Database Design (3 sessions) High-level conceptual modeling, ER Modeling concepts, ER Diagrams, Cardinality constraints, Higher-order relationships, Enhanced ER Model (EER), Weak-entity types, Subclasses and inheritance, Specialization and Generalization, Modeling of UNION types using categories</p>	<h2>Computer Science and Engineering</h2>
<p><b>Module 3:</b> Relational Model, Languages and Systems (7 sessions) Relational algebra (2 sessions): Relational model concepts, Relational integrity constraints, Update operations on relations, Relational algebra model, ER to relational mapping</p>	<p><b>Coordinators:</b> <b>Dr. S. Srinath</b> IIT Bangalore</p>
<p>SQL (2 sessions): Data definition in SQL, Queries and update statements, Views, Integrity constraints, Specifying indexes, Embedded SQL.</p>	<p><b>Prof. D. Janaki Ram</b> Department of Computer Science and Engineering IIT Madras</p>
<p>IBM DB2 case study (2 sessions): Architecture of DB2, Data definition and manipulation in DB2.</p>	
<p>EER to Relational mapping (1 session) <b>Module 4:</b> Database design using the relational model (4 sessions) Functional dependencies (2 sessions): Keys in a relational model, Concept of functional dependencies, Normal forms based on primary keys, Boyce-Codd Normal Forms</p>	
<p>Further Dependencies (2 sessions): Multi-values dependencies and fourth normal form, Join dependencies and fifth normal form, Inclusion dependencies, Other dependencies and normal forms</p>	
<p><b>Module 5:</b> Storage and Indexing Structures (6 sessions) Storage structures (3 sessions): Secondary storage devices, Buffering of blocks, File Organization, Heaps, Sorted Files, Hashing and overflow handling techniques, Dynamic hashing, Extensible hashing, Other file organizations</p>	
<p>Indexing methods (3 sessions): Basic terminology, Primary indexes, Clustering index, Secondary index, Multilevel indexes, ISAM, B-trees, B+ trees, inserting and searching algorithms for B+ trees, Other indexing methods</p>	
<p><b>Module 6:</b> Transaction Processing and Concurrency Control (6 sessions) Transaction Fundamentals (3 sessions): OLTP environments, Concurrency issues, need for transactions, Necessary properties of transactions (ACID properties), Transaction states, serializability, Serial schedules, Conflict serializability, View serializability, Recoverable and non-recoverable schedules, Cascading rollbacks, Cascadeless schedules</p>	
<p>Concurrency control (3 sessions): Serialized and non-serialized schedules, Testing for serializability, Locking, Lock compatibility matrix, Locking and serializability, Deadlocks and starvation, Two-phase locking (2PL) protocol, Conservative, strict and rigorous 2PL, 2PL with lock conversions, Timestamp-ordering based protocol, Multi-versioning protocol, Multi-granularity locking, Deadlock prevention protocols, Wait-die and wound-wait schemes, Time-out based schemes, Deadlock recovery, Nested transactions</p>	
<p><b>Module 7:</b> Database recovery techniques (3 sessions) Recovery concepts, Deferred updates technique, Immediate update technique, Shadow paging, ARIES recovery algorithm</p>	
<p><b>Module 8:</b> Query Processing and Optimization (2 sessions) Translating SQL into relational algebra, Basic query operations, Heuristics in query optimization, Selectivity and cost estimates in query optimization, Semantic query optimization</p>	
<p><b>Module 9:</b> Database Security and Authorization (1 session) Discretionary access control, Mandatory access control and multi-level security, Statistical database security</p>	
<p><b>Module 10:</b> Enhanced Data Models for specific applications (2 sessions) Active database concepts, Temporal databases, Spatial databases, multi-media databases</p>	
<p><b>Module 11:</b> Distributed databases and issues (3 sessions) Data fragmentation, replication and allocation in distributed databases, Types of distributed database systems Query processing in distributed databases, Concurrency control and recovery in distributed databases</p>	
<p><i>Textbook:</i> Elmasri, Navathe. <i>Fundamentals of Database Systems (Third Edition)</i>. Pearson Education, 2004.</p>	
<p>A joint venture by ISc and IITs, funded by MHRD, Govt of India</p>	
<p><a href="http://nptel.ac.in">http://nptel.ac.in</a></p>	

## Departmental Elective-VI

### RBT085: Biostatistics & design of experiments (NPTEL)

NPTEL Syllabus																					
<p><b>NOC: Biostatistics, and Design of Experiments - Video course</b></p> <p><b>COURSE OUTLINE</b></p> <p>Biostatistics is the application of statistics to different topics in biology including medicine, pharmacy, public health science, agriculture and fishery. It involves the analysis of data from experiments; its interpretation and drawing conclusion from the results. It is very relevant to all UG and PG level degree programmes majoring in Biotechnology and allied fields as well as practicing scientists. It involves the application of statistical theory to real-world problems, the practice of designing and conducting biomedical experiments and clinical trials. Design of experiments is planning experimental strategy, screening a large number of parameters and selecting the important ones, determining the minimum number of experiments and deciding on the mode and manner in which experiment have to be conducted. The course encompasses topics such as distribution of data, sample size, tests of significance, data reduction, regression analysis, comparison of performance of drugs in clinical trials, design of experiments, screening and second order designs.</p> <p><b>COURSE DETAIL</b></p> <table border="1"> <thead> <tr> <th>ModuleNo.</th> <th>Topics</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>Introduction to statistics (various distributions) Normal distribution Sample and population Sample and population</td> </tr> <tr> <td>2.</td> <td>Z distribution Z distribution/confidence interval Tests of significance – t test Tests of significance – t test</td> </tr> <tr> <td>3.</td> <td>Tests of significance – t test Tests of significance – t test Tests of significance – t test Tests of significance – t test</td> </tr> <tr> <td>4.</td> <td>F test ANOVA</td> </tr> <tr> <td>5.</td> <td>2 test/Odds ratio Non parametric tests Other tests</td> </tr> <tr> <td>6.</td> <td>Design of experiment- introduction Design of experiment Screening designs Screening design - Data analysis</td> </tr> <tr> <td>7.</td> <td>Screening design - Data analysis Higher order designs Higher order designs Higher order designs</td> </tr> <tr> <td></td> <td>Regression analysis</td> </tr> <tr> <td>8.</td> <td>Regression analysis Data reduction Data reduction</td> </tr> </tbody> </table>		ModuleNo.	Topics	1.	Introduction to statistics (various distributions) Normal distribution Sample and population Sample and population	2.	Z distribution Z distribution/confidence interval Tests of significance – t test Tests of significance – t test	3.	Tests of significance – t test Tests of significance – t test Tests of significance – t test Tests of significance – t test	4.	F test ANOVA	5.	2 test/Odds ratio Non parametric tests Other tests	6.	Design of experiment- introduction Design of experiment Screening designs Screening design - Data analysis	7.	Screening design - Data analysis Higher order designs Higher order designs Higher order designs		Regression analysis	8.	Regression analysis Data reduction Data reduction
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 <p><b>NPTEL</b> <a href="http://nptel.ac.in">http://nptel.ac.in</a></p> <p><b>Biotechnology</b></p> <p><b>Pre-requisites:</b> Basics of probability and statistics</p> <p><b>Coordinators:</b> <b>Prof. Mukesh Doble</b> Department of Biotechnology IIT Madras</p>																					
<p>A joint venture by ISc and IITB, funded by MHRD, Govt of India</p> <p style="text-align: right;"><a href="http://nptel.ac.in">http://nptel.ac.in</a></p>																					

## RBT086: Integrated waste management for smart cities (NPTEL)



**PROF. BRAJESH KUMAR DUBEY**  
Department of Civil Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core | UG/PG  
**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)  
**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : B.E./B.Tech, M.E./M.Tech, M.S, B.Sc, M.Sc, PhD, Field Professionals and Academicians

**PRE-REQUISITES** : Environmental Sciences, Introduction to Environmental Engineering

**INDUSTRIES APPLICABLE TO** : Larsen and Tourbo, Tata Group of Industries, Ramky Group of Industries, IF&S Environment

### **COURSE OUTLINE :**

This course has emphasises on Integrated Solid Waste Management aspects within the broad subject area of Integrated Waste Management for a Smart City. The issues of Municipal Solid Waste (MSW) management, Construction and Demolition (C&D) Waste and Electronic Waste Management will be covered in this course. The topics will include: generation rates and waste composition; Integrated waste management issues, collection, recovery, reuse, recycling, energy-from-waste, and landfilling; Biological treatment of the organic waste fraction - direct land application, composting, and anaerobic digestion. The environmental impact of waste management and its relationship on the big picture sustainable development and smart city development will be discussed. A major focus of this course will be the role of MSW management within the various initiatives of the Govt. of India including: Swachh Bharat Mission, Smart Cities as well as Make in India. The challenges of waste management for smart cities will also be discussed taking case studies from the first list of 20 smart cities identified in the first phase of this program. This will be followed by overview of the Construction and Demolition (C&D) Waste and Electronic Waste (E-Waste) management issues in India in general and for the smart cities in particular. The new rules with respect of C&D Waste and E-Waste Management will be covered. The challenges of managing these waste streams effectively will be discussed.

### **ABOUT INSTRUCTOR :**

Dr. Brajesh Kumar Dubey is an Associate Professor in the Division of Environmental Engineering and Management at Indian Institute of Technology (IIT), Kharagpur, India. Dr. Dubey has more than a decade of research, teaching, training and industrial outreach experience in the areas of Integrated Solid and Hazardous Waste Management, Life Cycle Assessment (LCA) and Sustainable Engineering. He has collaborated with UN agencies, World Bank, National Science Foundation, Ontario Ministry of Environment and Auckland Regional Council on various projects including that in the area of LCA.

### **COURSE PLAN :**

**Week 01** : Introduction to Solid Waste Management  
**Week 02** : Municipal Solid Waste Characteristics and Quantities  
**Week 03** : MSW Rules 2016, Swachh Bharat Mission and Smart Cities Program  
**Week 04** : Municipal Solid Waste Collection, Transportation, Segregation and Processing  
**Week 05** : Disposal of Municipal Solid Waste  
**Week 06** : Biochemical Processes and Composting  
**Week 07** : Energy Recovery from Municipal Solid Waste  
**Week 08** : Current Issues in Solid Waste Management and Review of MSW Management Status in First List of 20 Smart Cities in the Country  
**Week 09** : Construction and Demolition (C&D) Waste Management - Overview  
**Week 10** : C&D Waste - Regulation, Beneficial Reuse of C&D Waste Materials  
**Week 11** : Electronic Waste (E-Waste) Management - Issues and Status in India and Globally  
**Week 12** : E-Waste Management Rules 2016 and Management Challenges

## RBT087: Industrial Biotechnology (NPTEL)



**PROF. DEBABRATA DAS**  
Department of Biotechnology  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Elective | UG  
**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)  
**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B.E./B.Tech, M.E./M.Tech

**PRE-REQUISITES** : Knowledge in microbiology, Biochemistry and mathematics in 10+2 level

**INDUSTRIES APPLICABLE TO** : DuPont India, IFB Agra Industry, IOC; ONGC, Dr. Reddy's Laboratories, Biocon United beverages.

### **COURSE OUTLINE :**

The course aims to provide fundamental insights to exploit enzymes and microbes for the manufacturing of products which have a huge industrial significance. It uniquely blends the science and engineering with various biochemical processes to obtain products of diverse fields such as chemicals, food, bioenergy etc. The course introduces bioreactors, its types, operation methods and provides an experimental demonstration of the same. Strategies to obtain higher yields, design of the reactors and production of biofuels from microbes are thoroughly explained. Students of various disciplines such as biotechnology, chemical engineering, food engineering, and pharmaceutical industries can be benefitted from the course as it discusses the existing bioprocess applications such as wine and cheese making, antibiotics and vaccines etc. The course majorly focusses on the applications and allows students to gain practical knowledge rather than mere theory. Major bottlenecks for the operation of biochemical industries will be discussed.

### **ABOUT INSTRUCTOR :**

Dr. Debabrata Das pursued his doctoral studies from Indian Institute of Technology (IIT) Delhi. He is a Senior Professor at IIT Kharagpur. He was also associated as MNRE Renewable Energy Chair Professor. He has pioneered the promising R&D of Bioenergy production processes by applying fermentation technology. Prof. Das is involved in three different areas of research: Gaseous energy recovery from organic wastes; algal biorefinery and CO<sub>2</sub> sequestration; and microbial fuel cell. He is presently involved in teaching both undergraduate and post-graduate courses on Biochemical Reaction Engineering; Aspects of Biochemical Engineering; Bioprocess Plant and Equipment Design; and Bioprocess Technology for the students of Department of Biotechnology; Department of Chemical Engineering; Department of Chemistry and School Energy Science and Engineering.

### **COURSE PLAN :**

- Week 01** : Introduction, Microbes and enzymes of industrial importance
- Week 02** : Different types of bioreactors and bioreactor design
- Week 03** : Microbial growth, substrate degradation and product formation kinetics, Tutorial 1
- Week 04** : Instrumentation, Sterilization of air, media and reactor
- Week 05** : Upstream and Downstream processing
- Week 06** : Production of Oxychemicals I
- Week 07** : Production of Oxychemicals II
- Week 08** : Production of Oxychemicals III
- Week 09** : High fructose corn syrup, Cheese making, and Single cell production
- Week 10** : Vaccines production and Metal leaching
- Week 11** : Bioenergy- Gaseous fuels: Biohydrogen, Biomethane and Microbial fuel cell; Liquid fuels: Bioethanol, Biodiesel and Biobutanol
- Week 12** : Aerobic and Anaerobic wastewater treatment processes

## RBT088: Computer aided drug design (NPTEL)



**PROF. MUKESH DOBLE**  
Department of Biotechnology & Bioengineering  
IIT Madras

**TYPE OF COURSE** : Rerun | Core | UG/PG  
**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)  
**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : B.E./B.Tech, M.E./M.Tech

**PRE-REQUISITES** : Prior knowledge of biochemistry, bioinformatics

**INDUSTRIES APPLICABLE TO** : Pharmaceutical industries/Biopharma/biotech

### **COURSE OUTLINE :**

Drug discovery and development is a time consuming and expensive process, taking about 10 years and costing about US 1.0 B dollars. Several candidates that enter clinical trials fail because of several reasons. Computer assisted drug design can speed up the process, reduce surprises and predict the properties, thereby reduce the cost of R&D. The course will cover structure and target based design, molecular modeling, quantum mechanics, drug likeness properties, QSAR and pharmacokinetic and dynamics using several softwares that are freely available.

### **ABOUT INSTRUCTOR :**

Prof. Mukesh Doble is a Professor at the Department of Biotechnology at IIT Madras. He Has previously worked in Imperial chemical Industries (ICI) and General Electric (GE) for 20 years. Areas of research are Biomaterials, Biopolymers, and Drug design. He has Published 280 papers and 10 books and filed 10 patents (including two US). He has delivered online video courses in Downstream processes, Medical Biomaterials and Biostatistics and Design of Experiments

### **COURSE PLAN :**

**Week 01** : Introduction to drug discovery  
**Week 02** : Structure and property  
**Week 03** : ADME-rules  
**Week 04** : Force field/MM/QM  
**Week 05** : Boundary conditions/Conformation  
**Week 06** : QSAR/Pharmacophore  
**Week 07** : Enzymes/proteins structures/docking  
**Week 08** : PK/PD

**DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY,  
LUCKNOW**



**Open Electives  
For  
Bachelor of Technology  
(Choice Based Credit System)**

**7<sup>th</sup> & 8<sup>th</sup> Semester, 2019-20**

<b>Open Electives for B.Tech 4<sup>th</sup> year (CBCS)</b>		
<b>Open Electives I (VII Semester )</b>		
Sl. No.	Subject Code	Name of Elective(s)
1	ROE071	Modelling and Simulation of Dynamic Systems
2	ROE072	Introduction to Smart Grid
3	ROE073	Cloud computing
4	ROE074	Understanding the human being Comprehensively Human Aspiration audits fulfilment
<b>Open Electives II (VIII Semester )</b>		
Sl. No.	Subject Code	Name of Elective(s)
1	ROE081	Digital and Social Media Marketing
2	ROE082	Entrepreneurship Development
3	ROE083	Machine Learning
4	ROE084	Micro and Smart Systems
5	ROE085	Operations Research
6	ROE086	Renewable Energy Resources
7	ROE087	*Human Values in Madhyasth Darshan
8	ROE088	*Values, Relationship & Ethical Human Conduct-For a Happy & Harmonious Society

**Note:**

- 1. The Student shall choose an open Elective from the list in such a manner that he/she has not studied the same course in any form during the degree programme.**
- 2. \* It is mandatory that for these two subjects ( ROE087 & ROE088) only trained faculty ( who had done the FDP for these courses) will teach the courses.**

- UNIT-I** Introduction to Digital Marketing: The new digital world - trends that are driving shifts from traditional marketing practices to digital marketing practices, the modern digital consumer and new consumer's digital journey. Marketing strategies for the digital world-latest practices.
- UNIT-II** Social Media Marketing -Introduction to Blogging, Create a blog post for your project. Include headline, imagery, links and post, Content Planning and writing. Introduction to Face book, Twitter, Google +, LinkedIn, YouTube, Instagram and Pinterest; their channel advertising and campaigns
- UNIT-III** Acquiring & Engaging Users through Digital Channels: Understanding the relationship between content and branding and its impact on sales, search engine marketing, mobile marketing, video marketing, and social-media marketing. Marketing gamification, Online campaign management; using marketing analytic tools to segment, target and position; overview of search engine optimization (SEO).
- UNIT-IV** Designing Organization for Digital Success: Digital transformation, digital leadership principles, online P.R. and reputation management. ROI of digital strategies, how digital marketing is adding value to business, and evaluating cost effectiveness of digital strategies
- UNIT-V** Digital Innovation and Trends: The contemporary digital revolution, digital transformation framework; security and privatization issues with digital marketing Understanding trends in digital marketing – Indian and global context, online communities and co-creation,

**Text books:**

1. Moutsy Maiti: Internet Marketing, Oxford University Press India
2. Vandana, Ahuja; Digital Marketing, Oxford University Press India (November, 2015).
3. Eric Greenberg, and Kates, Alexander; Strategic Digital Marketing: Top Digital Experts Share the Formula for Tangible Returns on Your Marketing Investment; McGraw-Hill Professional (October, 2013).
4. Ryan, Damian; Understanding Digital Marketing: marketing strategies for engaging the digital generation; Kogan Page (3rd Edition, 2014).
5. Tracy L. Tuten & Michael R. Solomon: Social Media Marketing (Sage Publication)

**ROE082 ENTREPRENEURSHIP DEVELOPMENT****L T P 3 0 0**

- UNIT-I** Entrepreneurship- definition. growth of small scale industries in developing countries and their positions vis-a-vis large industries; role of small scale industries in the national economy; characteristics and types of small scale industries; demand based and resources based ancillaries and sub-control types. Government policy for small scale industry; stages in starting a small scale industry.
- UNIT-II** Project identification- assessment of viability, formulation, evaluation, financing, field-study and collection of information, preparation of project report, demand analysis, material balance and output methods, benefit cost analysis, discounted cash flow, internal rate of return and net present value methods.
- UNIT-III** Accountancy- Preparation of balance sheets and assessment of economic viability, decision making, expected costs, planning and production control, quality control, marketing, industrial relations, sales and purchases, advertisement, wages and incentive, inventory control, preparation of financial reports, accounts and stores studies.
- UNIT-IV** Project Planning and control: The financial functions, cost of capital approach in project planning and control. Economic evaluation, risk analysis, capital expenditures, policies and practices in public enterprises. profit planning and programming, planning cash flow, capital expenditure and operations. control of financial flows, control and communication.
- UNIT-V** Laws concerning entrepreneur viz, partnership laws, business ownership, sales and income taxes and workman compensation act. Role of various national and state agencies which render assistance to small scale industries.

**Text books:**

1. Forbat, John, "Entrepreneurship" New Age International.
2. Havinal, Veerbhadrappa, "Management and Entrepreneurship" New Age International
3. Joseph, L. Massod, "Essential of Management", Prentice Hall of India

ROE083

**MACHINE LEARNING**

**L T P 3 0 0**

**UNIT-I**

INTRODUCTION – Well defined learning problems, Designing a Learning System, Issues in Machine Learning; THE CONCEPT LEARNING TASK - General-to-specific ordering of hypotheses, Find-S, List then eliminate algorithm, Candidate elimination algorithm, Inductive bias

**UNIT-II**

DECISION TREE LEARNING - Decision tree learning algorithm-Inductive bias- Issues in Decision tree learning; ARTIFICIAL NEURAL NETWORKS – Perceptrons, Gradient descent and the Delta rule, Adaline, Multilayer networks, Derivation of backpropagation rule Backpropagation Algorithm Convergence, Generalization;

**UNIT-III**

Evaluating Hypotheses: Estimating Hypotheses Accuracy, Basics of sampling Theory, Comparing Learning Algorithms; **Bayesian Learning:** Bayes theorem, Concept learning, Bayes Optimal Classifier, Naïve Bayes classifier, Bayesian belief networks, EM algorithm;

**UNIT-IV**

**Computational Learning Theory:** Sample Complexity for Finite Hypothesis spaces, Sample Complexity for Infinite Hypothesis spaces, The Mistake Bound Model of Learning; INSTANCE-BASED LEARNING – k-Nearest Neighbour Learning, Locally Weighted Regression, Radial basis function networks, Case-based learning

**UNIT-V**

**Genetic Algorithms:** an illustrative example, Hypothesis space search, Genetic Programming, Models of Evolution and Learning; Learning first order rules-sequential covering algorithms-General to specific beam search-FOIL; REINFORCEMENT LEARNING - The Learning Task, Q Learning.

**Text books:**

1. Tom M. Mitchell, —Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
2. Ethem Alpaydin, —Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004.
3. Stephen Marsland, —Machine Learning: An Algorithmic Perspective, CRC Press, 2009.
4. Bishop, C., Pattern Recognition and Machine Learning. Berlin: Springer-Verlag.

**ROE084 MICRO AND SMART SYSTEMS**

**L T P 3 0 0**

**UNIT-I** Introduction, Why miniaturization?, Microsystems versus MEMS, Why micro fabrication?, smart materials, structures and systems, integrated Microsystems, applications of smart materials and Microsystems.

**UNIT-II** Micro sensors, actuators, systems and smart materials: Silicon capacitive accelerometer, piezoresistive pressure sensor, conductometric gas sensor, an electrostatic combo-drive, a magnetic microrelay, portable blood analyzer, piezoelectric inkjet print head, micromirror array for video projection, smart materials and systems.

**UNIT-III** Micromachining technologies: silicon as a material for micro machining, thin film deposition, lithography, etching, silicon micromachining, specialized materials for Microsystems, advanced processes for micro fabrication.

**UNIT-IV** Modeling of solids in Microsystems: Bar, beam, energy methods for elastic bodies, heterogeneous layered beams, bimorph effect, residual stress and stress gradients, poisson effect and the anticlastic curvature of beams, torsion of beams and shear stresses, dealing with large displacements, In-plane stresses, Modelling of coupled electromechanical systems: electrostatics, Coupled Electro-mechanics: statics, stability and pull-in phenomenon, dynamics. Squeezed film effects in electromechanics.

**UNIT-V** Integration of micro and smart systems: integration of Microsystems and microelectronics, microsystems packaging, case studies of integrated Microsystems, case study of a smart-structure in vibration control. Scaling effects in Microsystems: scaling in: mechanical domain, electrostatic domain, magnetic domain, diffusion, effects in the optical domain, biochemical phenomena.

**Text books:**

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat and V. K. Atre, "Micro and smart systems", Wiley India, 2010.

**UNIT-I** Introduction: Definition and scope of operations research (OR), OR model, solving the OR model, art of modelling, phases of OR study. Linear Programming: Two variable Linear Programming model and Graphical method of solution, Simplex method, Dual Simplex method, special cases of Linear Programming, duality, sensitivity analysis.

**UNIT-II** Transportation Problems: Types of transportation problems, mathematical models, transportation algorithms, Assignment: Allocation and assignment problems and models, processing of job through machines.

**UNIT-III** Network Techniques: Shortest path model, minimum spanning Tree Problem, Max-Flow problem and Min-cost problem. Project Management: Phases of project management, guidelines for network construction, CPM and PERT.

**UNIT-IV** Theory of Games : Rectangular games, Minimax theorem, graphical solution of  $2 \times n$  or  $m \times 2$  games, game with mixed strategies, reduction to linear programming model. Quality Systems: Elements of Queuing model, generalized poisson queing model, single server models.

**UNIT-V** Inventory Control: Models of inventory, operation of inventory system, quantity discount. Replacement: Replacement models: Equipments that deteriorate with time, equipments that fail with time.

**Text books:**

1. Wayne L. Winston, "Operations Research" Thomson Learning, 2003.
2. Hamdy H. Taha, "Operations Research-An Introduction" Pearson Education, 2003.
3. R. Panneer Seevam, "Operations Research" PHI Learning, 2008.
4. V.K.Khanna, "Total Quality Management" New Age International, 2008.

- UNIT-I** **Introduction:** Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits. **Solar Cells:** Theory of solar cells. Solar cell materials, solar cell array, solar cell power plant, limitations.
- UNIT-II** **Solar Thermal Energy:** Solar radiation, flat plate collectors and their materials, applications and performance, focussing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.
- UNIT-III** **Geothermal Energy:** Resources of geothermal energy, thermodynamics of geothermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations. **Magneto-hydrodynamics (MHD):** Principle of working of MHD Power plant, performance and limitations. **Fuel Cells:** Principle of working of various types of fuel cells and their working, performance and limitations.
- UNIT-IV** Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations. **Wind Energy:** Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. performance and limitations of energy conversion systems.
- UNIT-V** Bio-mass: Availability of bio-mass and its conversion theory. **Ocean Thermal Energy Conversion (OTEC):** Availability, theory and working principle, performance and limitations. **Wave and Tidal Wave:** Principle of working, performance and limitations. Waste Recycling Plants.

**Text books:**

1. Raja et al, "Introduction to Non-Conventional Energy Resources" Scitech Publications.
2. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006.
3. M.V.R. Koteswara Rao, "Energy Resources: Conventional & Non-Conventional" BSP Publications, 2006.
4. D.S. Chauhan, "Non-conventional Energy Resources" New Age International.
5. C.S. Solanki, "Renewal Energy Technologies: A Practical Guide for Beginners" PHI Learning.
6. Peter Auer, "Advances in Energy System and Technology". Vol. 1 & II Edited by Academic Press.
7. Godfrey Boyle, "Renewable Energy Power For A Sustainable Future", Oxford University Press.



**Text Books:**

1. Nagraj, A., “Manav Vyavahar Darshan”, Jeevan Vidya Prakashan, 3rd edition, 2003.

**References:**

1. Nagraj, A., “Vyavaharvadi Samajshastra”, Jeevan Vidya Prakashan, 2nd edition, 2009.
2. Nagraj, A., “Avartanasheel Arthashastra”, Jeevan Vidya Prakashan, 1st edition, 1998.

**Mode of Evaluation:**

Assignment/ Seminar/Continuous Assessment Test/Semester End Exam

**ROE088 VALUES, RELATIONSHIP & ETHICAL HUMAN CONDUCT–FOR A  
HAPPY & HARMONIOUS SOCIETY** **L T P 3 0 0**

**Pre-requisites- for this subject only those faculty will teach these courses who had done the FDP for these courses.**

**Course Objectives:**

1. To help the students to understand the importance and types of relationship with expressions.
2. To develop the competence to think about the conceptual framework of undivided society as well as universal human order.
3. To help the students to develop the exposure for transition from current state to the undivided society and universal human order.

**Course Methodology:**

1. The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.
2. It is free from any dogma or set of do's and don'ts related to values.
3. It is a process of self-investigation and self-exploration, and not of giving sermons. Whatever is found as truth or reality is stated as a proposal and the students are facilitated and encouraged to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation.
4. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student leading to continuous self-evolution.
5. This self-exploration also enables them to critically evaluate their pre-conditionings and present beliefs.

**UNIT-I**

**Introduction to the course:** Basic aspiration of a Human Being and program for its fulfillment, Need for family and relationship for a Human Being, Human-human relationship and role of behavior in its fulfillment, Human-rest of Nature relationship and role of work in its fulfillment, Comprehensive Human Goal, Need for Undivided Society, Need for Universal Human Order, an appraisal of the Current State, Appraisal of Efforts in this Direction in Human History.

**UNIT-II**

**Understanding Human-Human Relationship & its fulfillment:** Recognition of Human-Human Relationship, Recognition of feelings in relationship, Established Values and Expressed Values in Relationship, interrelatedness of feelings and their fulfillment, Expression of feelings, Types of relationship and their purpose, mutual evaluation in relationship, Meaning of justice in relationship, Justice leading to culture, civilization and Human Conduct.

**UNIT-III**

**Justice from family to world family order:** Undivided Society as continuity and expanse of Justice in behavior – family to world family order, continuity of culture and civilization, Universal Order on the basis of Undivided Society, Conceptual Framework for Universal human order, Universal Human Order as continuity and expanse of order in living: from family order to world family order, a conceptual framework for universal human order.

**UNIT-IV** Program for Ensuring Undivided Society and Universal Human Order:  
Education – Sanskar, Health – Sanyam, Production-work, Exchange – storage,  
Justice-preservation.

**UNIT-V** Human Tradition: Scope and Steps of Universal Human Order, Human  
Tradition ( Ex. Family order to world family order), Steps for transition from the  
current state, Possibilities of participation of students in this direction, Present  
efforts in this direction, Sum up.

**Text books:**

1. A Foundation Course in Human Values and Profession Ethics (Text Book and Teachers' Manual), R. R. Gaur, R. Asthana, G. P. Bagaria (2010), Excel Books, New Delhi.
2. Avartansheel Arthshastra, A. Nagraj, Divya Path Sansthan, Amarkantak, India.
3. An Appeal by the Dalai Lama to the World: Ethics Are More Important Than Religion , Dalai Lama XIV, 2015.
4. Economy of Permanence – (a quest for social order based on non-violence), J. C. Kumarappa (2010), Sarva-Seva-Sangh-Prakashan, Varansi, India.
5. Energy and Equity, Ivan Illich (1974), The Trinity Press, Worcester & Harper Collins, USA.
6. Human Society, Kingsley Davis, 1949.
7. Hind Swaraj or, Indian home rule Mohandas K. Gandhi, 1909.
8. Integral Humanism, Deendayal Upadhyaya, 1965.
9. Lohiya Ke Vichar, Lok Bharti , Rammanohar Lohiya, 2008.
10. Manav Vyavahar Darshan, A. Nagraj, Divya Path Sansthan, Amarkantak, India.
11. Manaviya Sanvidhan, A. Nagraj, Divya Path Sansthan, Amarkantak, India
12. Samadhanatmak Bhautikvad, A. Nagraj, Divya Path Sansthan, Amarkantak, India
13. Small Is Beautiful: A Study of Economics as if People Mattered, E. F. Schumacher, 1973, Blond & Briggs, UK.
14. Slow is Beautiful, Cecile Andrews (<http://www.newsociety.com/Books/S/Slow-is-Beautiful>)
15. Sociology Themes and Perspectives, Harper Collins; EIGHT edition (2014), Martin Holborn and Peter Langley, 1980.
16. Samagra kranti: Jaya Prakash Narayan's philosophy of social change, Siddharth Publications Renu Sinha, 1996.
17. Science & Humanism – towards a unified worldview, P. L. Dhar & R. R. Gaur (1990), Commonwealth Publishers, New Delhi
18. Vyavaharvadi Samajshastra, A. Nagraj, Divya Path Sansthan, Amarkantak, India.
19. Vyavahatmak Janvad, A. Nagraj, Divya Path Sansthan, Amarkantak, India.
20. The Communist Manifesto, Karl Marx, 1848.
21. Toward a True Kinship of Faiths: How the World's Religions Can Come Together Dalai Lama XIV, 2011.

**Reference Videos.**

1. kin school (30 minutes)
2. Technology (Solar City etc.).
3. Natural Farming.
4. Economics of Happiness ( 1h 8m)

# Modelling and Simulation of Dynamic Systems

## Unit 1- Introduction to modeling and simulation:

Introduction to modeling, Examples of models, modeling of dynamic system, Introduction to simulation, MATLAB as a simulation tool, Bond graph modeling, causality, generation of system equations,

## Unit 2- Bond graph modeling of dynamic system:

Methods of drawing bond graph model- Mechanical systems & Electrical systems, some basic system models- Mechanical systems, Thermal systems, hydraulic systems, pneumatic systems and electrical systems.

## Unit 3- System models of combined systems:

Linearity and non linearity in systems combined rotary and translatory system, electro mechanical system, hydro-mechanical system,

## Unit 4- Dynamic Response and System Transfer Function:

Dynamic response of 1<sup>st</sup> order system and 2<sup>nd</sup> order system, performance measures for 2<sup>nd</sup> order system, system transfer function, transfer function of 1<sup>st</sup> and 2<sup>nd</sup> order system Block diagram algebra, signal flow diagram, state variable formulation, frequency response and bode plots.

## Unit 5- Simulation and simulation applications:

Simulation using SIMULINK, examples of simulation problems- simple and the compound pendulum, planner mechanisms, validation and verification of the simulation model, parameter estimation methods, system identifications, introduction to optimization,

## Course Outcomes:

On completion of this course, students will be able to

- Define, describe and apply basic concepts related to modeling and simulation.
- Construct bond graphs for the type of systems mentioned above, simplify and analyze the bond graph according to causality conflicts, and from a given bond graph without conflicts.
- Use conservation laws and constitutive relationships and other physical relations to model mechanical, electrical and flow systems, and combinations of these.
- Find dynamic response and transfer function using various tools for system modeling.
- Model and simulate mechanical and electrical systems using the computer tools Simulink.

## Reference:

- Zeigler B.P. Praehofer. H. and Kim I.G. "Theory of modeling and simulation", 2nd Edition. Academic press 2000
- Robert L. Woods, Kent L. Lawrence, "Modeling and simulation of dynamic systems", Person, 1997.
- Brown, Forbes T. "Engineering System Dynamics", New York, NY: CRC, 2001. ISBN: 9780824706166.
- Pratab.R " Getting started with MATLAB" Oxford university Press 2009

**Unit-I: Introduction:**

Introduction to Smart Grid: Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient & Self Healing Grid, Present development & International policies in Smart Grid. Case study of Smart Grid. CDM opportunities in Smart Grid.

**Unit-II: Smart Grid Technologies:**

Introduction to Smart Meters, Real Time Pricing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation.

**Unit-III: Smart Grid Technologies:**

Smart Substations, Substation Automation, Feeder Automation, Geographic Information System (GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU), PMUs application to monitoring & control of power system.

**Unit-IV: Microgrids and Distributed Energy Resources:**

Concept of microgrid, need & application of microgrid, formation of microgrid, Issues of interconnection, protection & control of microgrid, Plastic & Organic solar cells, thin film solar cells, Variable speed wind generators, fuel cells, microturbines, Captive power plants, Integration of renewable energy sources.

**Unit V: Power Quality Management in Smart Grid:**

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring.

**Text Books:**

1. Ali Keyhani, Mohammad N. Marwali, Min Dai, "Integration of Green and Renewable Energy in Electric Power Systems", Wiley.
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press.
3. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley.
4. Jean Claude Sabonnadiere, NouredineHadjsaid, "Smart Grids", Wiley Blackwell 19.
5. Stuart Borlase, "Smart Grids (Power Engineering)", CRC Press.

**Reference Books:**

6. Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability", Artech House Publishers July 2011.
7. James Northcote, Green, Robert G. Wilson "Control and Automation of Electric Power Distribution Systems (Power Engineering)", CRC Press.
8. MladenKezunovic, Mark G. Adamiak, Alexander P. Apostolov, Jeffrey George Gilbert "Substation Automation (Power Electronics and Power Systems)", Springer

9. R.C. Dugan, Mark F. McGranhan, Surya Santoso, H. Wayne Beaty, "Electrical Power System Quality", 2<sup>nd</sup> Edition, McGraw Hill Publication.
10. Phadke, A.G., Thorp, J.S., "Synchronized Phasor Measurements and Their Applications", Springer.
11. James Momoh, "Smart Grid: Fundamentals of Design and Analysis", Wiley.

<b>Cloud Computing</b>		
<b>Course Outcome ( CO)</b>		<b>Bloom's Knowledge Level (KL)</b>
<b>At the end of course , the student will be able to understand</b>		
CO 1	Articulate the main concepts, key technologies, strengths and limitations of cloud computing.	K <sub>1</sub> , K <sub>2</sub>
CO 2	Learn the key and enabling technologies that help in the development of cloud.	K <sub>2</sub> , K <sub>4</sub>
CO 3	Develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.	K <sub>2</sub> , K <sub>3</sub>
CO 4	Explain the core issues of cloud computing such as resource management and security.	K <sub>2</sub> , K <sub>3</sub>
CO 5	To appreciate the emergence of cloud as the next generation computing paradigm.	K <sub>1</sub> , K <sub>2</sub>
<b>DETAILED SYLLABUS</b>		<b>3-0-0</b>
<b>Unit</b>	<b>Topic</b>	<b>Proposed Lecture</b>
<b>I</b>	<b>INTRODUCTION</b> Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning.	<b>08</b>
<b>II</b>	<b>CLOUD ENABLING TECHNOLOGIES</b> Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish-Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices – Virtualization Support and Disaster Recovery.	<b>08</b>
<b>III</b>	<b>CLOUD ARCHITECTURE, SERVICES AND STORAGE</b> Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds – IaaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3.	<b>08</b>
<b>IV</b>	<b>RESOURCE MANAGEMENT AND SECURITY IN CLOUD</b> Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM – Security Standards.	<b>08</b>
<b>V</b>	<b>CLOUD TECHNOLOGIES AND ADVANCEMENTS</b> Hadoop – MapReduce – Virtual Box — Google App Engine – Programming Environment for Google App Engine — Open Stack – Federation in the Cloud – Four Levels of Federation – Federated Services and Applications – Future of Federation.	<b>08</b>
<b>Text books:</b>		

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012.
2. Rittinghouse, John W., and James F. Ransome, —Cloud Computing: Implementation, Management and Security, CRC Press, 2017.
3. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, —Mastering Cloud Computing, Tata Mcgraw Hill, 2013.
4. Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing – A Practical Approach, Tata Mcgraw Hill, 2009.
5. George Reese, “Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O’Reilly, 2009.

**Subject Name: Understanding the Human Being Comprehensively – Human Aspirations and its Fulfillment**

**Pre-requisites- AUC-001 or RVE 301/401 “Universal Human Values and Professional Ethics”**

**Subject Code: ROE074**

**[L-T-P: 3-0-0]**

**Course Objectives:**

1. To help the students having the clarity about human aspirations, goal, activities and purpose of life.
2. To facilitate the competence to understand the harmony in nature/existence and participation of human being in the nature/existence.
3. To help the students to develop the understanding of human tradition and its various components.

**Course Methodology:**

1. The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.
2. It is free from any dogma or set of do's and don'ts related to values.
3. It is a process of self-investigation and self-exploration, and not of giving sermons. Whatever is found as truth or reality is stated as a proposal and the students are facilitated and encouraged to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation.
4. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student leading to continuous self-evolution.
5. This self-exploration also enables them to critically evaluate their pre-conditionings and present beliefs.

**Module 1: Introduction**

The basic human aspirations and their fulfillment through Right understanding and Resolution; All-encompassing Resolution for a Human Being, its details and solution of problems in the light of Resolution

**Module 2: Understanding Human being and its expansion.**

The domain of right understanding starts from understanding the human being (the knower, the experiencer and the doer); and extends up to understanding nature/existence – its interconnectedness and co-existence; and finally understanding the role of human being in existence (human conduct).

**Module 3: Activities of the Self.**

Understanding the human being comprehensively is the first step and the core theme of this course; human being as co-existence of the self and the body; the activities and potentialities of the self; Reasons for harmony/contradiction in the self

**Module 4: Understanding Co-existence with other orders.**

The need and the process of inner evolution (through self-exploration, self-awareness and self-evaluation)- particularly awakening to activities of the Self: Realization, Understanding and Contemplation in the Self (Realization of Co-Existence, Understanding of Harmony in Nature and Contemplation of Participation of Human in this harmony/ order leading to comprehensive knowledge about the existence).

**Module 5: Expansion of harmony from self to entire existence.**

Understanding different aspects of All-encompassing Resolution (understanding, wisdom, science etc.), Holistic way of living for Human Being with All-encompassing Resolution covering all four dimensions of human endeavour viz., realization, thought, behavior and work (participation in the larger order) leading to harmony at all levels from self to Nature and entire Existence

**Reference Books:**

1. A Foundation Course in Human Values and Profession Ethics (Text Book and Teachers' Manual), R. R. Gaur, R. Sangal, G. P. Bagaria (2010), Excel Books, New Delhi [ISBN 978-8-174-46781-2]
2. Avartansheel Arthshastra, A. Nagraj, Divya Path Sansthan, Amarkantak, India
3. Economy of Permanence – (a quest for social order based on non-violence), J. C. Kumarappa (2010), Sarva-Seva-Sangh-Prakashan, Varansi, India
4. Energy and Equity, Ivan Illich (1974), The Trinity Press, Worcester & Harper Collins, USA
5. IshandiNauUpnishad, Shankaracharya, Geeta press, Gorakhpur,
6. Manav Vyavahar Darshan, A. Nagraj, Divya Path Sansthan, Amarkantak, India
7. Manaviya Sanvidhan, A. Nagraj, Divya Path Sansthan, Amarkantak, India
8. MahasatipatthanSutta , S N Goenka, Vipassana Research Institute, First Edition, 1996
9. Small Is Beautiful: A Study of Economics as if People Mattered, E. F. Schumacher, 1973, Blond & Briggs, UK
10. Slow is Beautiful, Cecile Andrews <http://www.newsociety.com/Books/S/Slow-is-Beautiful>)
11. Science & Humanism – towards a unified worldview, P. L. Dhar & R. R. Gaur (1990), Commonwealth Publishers, New Delhi
12. Sanchian Sri Guru Granth Sahib Ji ,Shiromani GurdwaraParbhandhak Committee, 2001
13. SamanSuttam, JinendraVarni ,1974.
14. Vyavaharvadi Samajshastra, A. Nagraj, Divya Path Sansthan, Amarkantak, India
15. Vyavahatmak Janvad, A. Nagraj, Divya Path Sansthan, Amarkantak, India.