Shivaji University, Kolhapur

Syllabus Structure of Second Year [S.E.] Engineering Course

Scheme of Teaching and Examination

SEMESTER – III

Sr. No.	Name of the Subject	Teaching Scheme(Hrs)				Examination Scheme (Marks)			
		L	T	P	Total	Theory	TW	Pract./ Oral	Total
1	Engineering Mathematics-III	3	1	---	4	100	25	---	125
2	Microbiology	4	--	4	8	100	25	50	175
3	Cell Biology	4	---	2	6	100	25	25	150
4	Macromolecules and Biomembranes	4	---	2	6	100	25	25	150
5	Unit Operations-I	3	---	2	5	100	25	25	150
6	Microbial Identification studies	--	--	2	2	--	25	--	25
7	Soft skills-I	--	1	--	1	--	25	--	25
	Total	**18**	**2**	**12**	**32**	**500**	**175**	**125**	**800**

Shivaji University, Kolhapur

Syllabus Structure of Second Year [S.E.] Engineering Course

Scheme of Teaching and Examination

SEMESTER – IV

Sr. No.	Name of the Subject	Teaching Scheme(Hrs)				Examination Scheme (Marks)			
		L	T	P	Total	Theory	TW	Pract./ Oral	Total
1	Biostatistics	3	1	--	4	100	25	---	125
2	Unit operations-II	4	--	2	6	100	25	25	150
3	Enzyme Technology	4	---	2	6	100	25	25	150
4	Metabolic pathways and their regulation	3	---	2	5	100	25	25	150
5	Molecular Biology	4	---	4	8	100	25	50	175
6	Basic Computer languages skills	--	---	2	2	---	25	--	25
7	Soft skills-II	--	1	--	1	---	25	---	25
	Total	**18**	**2**	**12**	**32**	**500**	**175**	**125**	**800**

Shivaji University, Kolhapur

Syllabus Structure of Third Year [T.E.] Engineering Course

Scheme of Teaching and Examination

SEMESTER – V

Sr. No.	Name of the Subject	Teaching Scheme(Hrs)				Examination Scheme (Marks)			
		L	T	P	Total	Theory	TW	Pract./ Oral	Total
1	Biological Thermodynamics	4	-	-	4	100	25	-	125
2	Immunology	4	-	2	6	100	25	50	175
3	Fermentation Technology	4	-	2	6	100	25	25	150
4	Genetic Engineering	4	-	2	6	100	25	25	150
5	Bioinformatics	4	-	2	6	100	25	25	150
6	Basics of cell culture		-	2	2	--	25	--	25
7	Seminar-I	-	-	2	2	--	25	--	25
	Total	**20**	**-**	**12**	**32**	**500**	**175**	**125**	**800**

Shivaji University, Kolhapur

Syllabus Structure of Third Year [T.E.] Engineering Course

Scheme of Teaching and Examination

SEMESTER – VI

Sr. No.	Name of the Subject	Teaching Scheme(Hrs)				Examination Scheme (Marks)			
		L	T	P	Total	Theory	TW	Pract./ Oral	Total
1	Bioinstrumentation	3	-	2	5	100	25	25	150
2	Medical Biotechnology	4	-	2	6	100	25	25	150
3	Microbial Technology	4	-	4	8	100	25	50	175
4	Drug Design and Gene Therapy	4	-	-	4	100	25	-	125
5	Industrial economics, management and entrepreneurship	3	-	-	4	100	-	-	100
6	Bioprocess Equipment Design and Drawing	2	-	2	4	-	50	25	75
7	Industrial Visits	-	-	2	2	-	25	-	25
	Total	**20**	**-**	**12**	**32**	**500**	**175**	**125**	**800**

Shivaji University, Kolhapur

Syllabus Structure of Final [B.E.] Engineering Course

Scheme of Teaching and Examination

SEMESTER –VII

Sr. No.	Name of the Subject	Teaching Scheme(Hrs)				Examination Scheme (Marks)			
		L	T	P	Total	Theory	TW	Pract./ Oral	Total
1	Bioreaction Engineering	4	-	2	6	100	25	25	150
2	Protein Engineering	4	-	--	4	100	25	--	125
3	Pharmaceutical Biotechnology	3	-	-	-	100	25	--	125
4	Bioprocesses	4	-	2	6	100	25	25	150
5	Elective-I	3	--	--	--	100	--	--	100
6	Seminar-II	--	--	2	2	--	25	--	25
7	Comprehensive tests [On all subjects from S.E to B.E-I]	--	--	2	2	--	50	--	50
8	Industrial Training (At the end of VI Semester -- 4 weeks)	--	--	--	--	--	50	--	50
9	Project Work**	--	--	4	4	--	25	--	25
	Total	**18**	**--**	**12**	**30**	**500**	**250**	**50**	**800**

**** THE PROJECT WORK SHOULD BE STARTED AT BEGINNING OF SEMESTER VII**

Elective I: 1) Animal Biotechnology
2) Plant Biotechnology
3) Good Manufacturing Practices
4) Biomedical Fluid Dynamics

Shivaji University, Kolhapur

Syllabus Structure of Final [B.E.] Engineering Course

Scheme of Teaching and Examination

SEMESTER –VIII

Sr. No.	Name of the Subject	Teaching Scheme(Hrs)				Examination Scheme (Marks)			
		L	T	P	Total	Theory	TW	Pract./ Oral	Total
1	Bioseparation processes	4	-	2	6	100	25	50	175
2	Bioprocess Modeling and Simulation	4	-	-	4	100	25	-	125
3	Bioprocess Engineering and Economics	4	-	-	4	100	--	-	100
4	Elective -- II	3	--	--	3	100	--	--	100
5	Elective—III	3	--	--	3	100	--	--	100
6	Biomedical Instrumentation	--	--	2	2	--	25	--	25
7	Project Work	--	--	6	6	--	75	100	175
	Total	**18**	**--**	**10**	**28**	**500**	**150**	**150**	**800**

Elective-II: 1) Introduction to Biomedical Engineering
2) Environmental Biotechnology
3) Biomaterials
4) Bioconjugate Technology

Elective -III: 1) Advanced Genetic Engineering
2) Food and dairy Biotechnology
3) Metabolic Engineering
4) Proteomics and Genomics

SHIVAJI UNIVERSITY, KOLHAPUR

SECOND YEAR ENGINEERING
[BIOTECHNOLOGY]

Syllabus

With effect from

Academic Year 2008-2009

Second Year Engineering
Biotechnology
Scheme of Teaching and Examination

SEMESTER – III

Sr. No.	Name of the Subject	Teaching Scheme(Hrs)				Examination Scheme (Marks)			
		L	T	P	Total	Theory	TW	Pract/ Oral	Total
1	Engineering Mathematics-III	3	1	---	4	100	25	---	125
2	Microbiology	4	--	4	8	100	25	50	175
3	Cell Biology	4	---	2	6	100	25	25	150
4	Macromolecules and Biomembranes	4	---	2	6	100	25	25	150
5	Unit Operations-I	3	---	2	5	100	25	25	150
6	Microbial Identification Studies	--	--	2	2	--	25	--	25
7	Soft Skills-I	--	1	--	1	--	25	--	25
	Total	**18**	**2**	**12**	**32**	**500**	**175**	**125**	**800**

SEMESTER – IV

Sr. No.	Name of the Subject	Teaching Scheme(Hrs)				Examination Scheme (Marks)			
		L	T	P	Total	Theory	TW	Pract. / Oral	Total
1	Biostatistics	3	1	--	4	100	25	---	125
2	Unit operations-II	4	--	2	6	100	25	25	150
3	Enzyme Technology	4	---	2	6	100	25	25	150
4	Metabolic Pathways and Their Regulation	3	---	2	5	100	25	25	150
5	Molecular Biology	4	---	4	8	100	25	50	175
6	Basic Computer Languages Skills	--	---	2	2	---	25	--	25
7	Soft Skills-II	--	1	--	1	---	25	---	25
	Total	**18**	**2**	**12**	**32**	**500**	**175**	**125**	**800**

Second Year Engineering
SEMESTER– III

Second Year Engineering: Semester-III

1. Engineering Mathematics-III

Teaching Scheme: Hrs
Examination Scheme: Marks
Lectures : 3
Theory : 100
Tutorial : 1
Term Work : 25

SECTION – I

Unit 1 Linear Differential Equations: Linear Differential Equations with constant coefficients, Homogenous Linear differential equations, method of variation of parameters.

Unit 2 Applications of Linear Differential Equations: Logistic law of population, Newton's law of cooling and chemical engineering problems. (Chemical reactions and solutions)

Unit 3 Fourier series: Definition, Euler's formulae, Dirchlet's Conditions for a Fourier expansion, Functions having points of discontinuity, change of interval, expansions of odd and even periodic functions, Half range series.

Unit 4 Fourier transforms: Fourier transforms, Fourier sine and cosine transforms, complex form of Fourier integral, Finite Fourier sine and cosine transforms.

SECTION – II

Unit 1 Laplace Transform: Definition, properties of Laplace transforms, transforms of derivatives, transforms of integral, Inverse Laplace transforms, Convolution theorem. Applications of Laplace transform to solve linear differential equations with constant coefficients

Unit 2 Vector Calculus: Differentiation of vectors, Gradient of scalar point function, Directional derivative, Divergence of vector point function, Curl of a vector point function.

Unit 3 Vector Integration: The line integral, Surface integral, volume integral, Gauss's Divergence theorem, Stoke's theorem, Green's theorem (Without proof). Irrotational and solenoidal vector field.

Unit 4 Convergence of Series: Ratio test, integral test, comparison test, Cauchy's root test, Raabe's test, Logarithmic test. Absolute and uniform convergence (Weirstrass's M- test).

General Instructions:

1. For the term work of 25 marks, batchwise tutorials are to be conducted. The number of students per batch should be as per University pattern for practical batches.
2. Minimum number of assignments should be 8 covering all topics.

Nature of Question paper:

1. There will be two sections carrying 50 marks each.
2. There will be four questions in each section and three questions should be attempted from each section.

Reference Books:

1. A text book of Applied Mathematics: Vol. I, II and III by J. N. Wartikar & P. N. Wartikar , Vidyarthi Griha Prakashan, Pune.
2. Higher Engineering Mathematics by Dr. B. S. Grewal.
3. Advanced Engineering Mathematics by Erwin Kreyszig.

Second Year Engineering: Semester-III

2. Microbiology

Teaching Scheme: Hrs
Examination Scheme: Marks
Lectures : 4
Theory : 100
Practical : 4
Term Work : 25

Practical/oral : 50

SECTION 1

Unit 1. Introduction to microorganisms 8

Contribution of various scientists in the development of microbiology, Role of microorganisms in the causation of disease and geochemical cycles.
Types and general characteristics of microorganisms: 1) Bacteria- Archaebacteria, Actinomycetes, Rickettsia, Mycoplasma, Chlamydia 2) Fungi – Molds and yeasts 3) Algae 4) Protozoa 5) Viruses.

Unit 2. The classification of bacteria 6

Species: The unit of classification, New approaches to bacterial taxonomy, Bacterial taxonomy the problems of taxonomic arrangements, Bacterial phylogeny.

Unit 3. The principles of microbial nutrition and microbial growth 10

The requirement for carbon nitrogen, sulfur and growth factors, the role of oxygen in nutrition, nutritional categories among microorganisms.
The definition of growth, the mathematical expression of growth; the typical bacterial growth curve, arithmetic growth, diauxic growth, synchronous growth, Batch and continuous culture: chemostat and turbidostat.

Unit 4. Methods in Microbiology
6
The construction of culture media, various types of media; Aseptic transfer techniques, Pure culture techniques- using liquid media, semisolid and solid media preservation of pure cultures, aerobic and anaerobic cultures, two-membered culture.

SECTION 2

Unit 1. Effect of the environmental factors on microbial growth 5
Effects of solutes on growth and metabolism, Effect of temperature on microbial growth, Effect of ion concentration, Effect of oxygen, Effect of hydrostatic pressure, Effect of heavy metal ions on microbial growth, Effect of UV light on microbial growth.

Unit 2. The Control of Microorganisms
12
Fundamentals of control, the theory and practice of sterilization
Physical agents –1) Temperature- moist heat and dry heat, incineration, boiling
2) Osmotic Pressure, 3) Radiations- ionizing and non-ionizing, 4) Surface Tension and Interfacial Tension, 5) Filtration.-types of bacterial filters, applications
Chemical agents – Selection of chemical agents for practical application, Major groups of antimicrobial agents, Evaluation of antimicrobial chemical agents. Gaseous sterilization;

Antibiotics and other chemotherapeutic agents – Chemotheraphy and Chemotherapeutic agents, Historical highlights, Characteristics of antibiotics and their mode of action, antifungal antibiotics, antitumor antibiotics, Synthetic chemotherapeutic agents, Microbial susceptibility to chemotherapeutic agents and Resistance to antibiotics.

Unit 3. Microbial genetics
6
Basic concept of Gene and its function.
Mutation – Basic concepts, Spontaneous and Induced mutations, mutagens.
Genetic exchange and recombination: Bacterial conjugation, Transduction, Transformation, Introduction to extrachromosomal genetic material.

Unit 4. Microbial Pathogenesis
7
Epidemiology of infectious diseases, Bacterial, Fungal, Protozoal, Viral Diseases; Bacterial invasion and colonization, Bacterial toxins- types and mode of action, Examples.

Text Books:
1. Microbiology – Fundamentals and Application, 6th Ed. – Purohit, S.S. (Agrobios)
2. General Microbiology, 7th Ed. – Schlegel H.G. (Cambridge University Press)
3. General Microbiology, 5h Ed. – Stanier R.Y. et al. (Macmilan press)
4. Microbiology, 5th Ed. – Pelczar, Jr. et al (Tata McGraw Hill)
5. Textbook of Microbiology, Anathnarayan and Panikar (Orient Longman)
6. Textbook of Microbiology, P.Charkborthy

Reference Books:

1. Topley and Wilson's Microbiology and Microbial infections 9th Ed. Vol 5 – Cox F.E.
G. et al. (Arnold Publisher Co.)
2. Talara K.P.'s Foundations in Microbiology, (McGraw Hill))

List of Experiments:

1. Introduction to Laboratory Equipments
i) Incubator
ii) Autoclave
iii) Hot air oven
iv) Centrifuge
v) Colorimeter
vi) Seitz filter
vii) pH meter
viii) Colony Counter
ix) Water bath
2) Study and use of microscope.
3. Preparation of laboratory media: Autoclaving, plating and streaking methods, preparation of slants and stabs.
4. Isolation and Identification of bacteria by streak plate method and observation of viable cells, cultural characteristics, morphological and biochemical characteristics.
i) Study of *Escherchia coli*
ii) Study of *Staphylococcus aureus*
5) Bacterial Staining
a) Monochrome
b) Negative (skin and oral microflora)
c) Gram
d) Capsule
e) Inclusion bodies
6) Study of bacterial growth curve and diauxic growth curve.
7) Effect of environmental factors on microbial growth: Temperature, pH, NaCl and Antibiotics.
8) Isolation of coliphages.
9) Mounting of molds
i) *Aspergillus*
ii) *Mucor*

iii) *Penicillium*

Second Year Engineering: Semester-III

3. Cell Biology

Teaching Scheme: Hrs
Examination Scheme: Marks
Lectures : 4
Theory : 100
Practical : 2
Term Work : 25

Practical/oral : 25

SECTION-I

Unit 1: Cell structure
12

a. Introduction to Prokaryotes and eukaryotes
b. Prokaryotic cell structure-
The bacterial nucleus, cell wall, capsules and slimes, Flagella and motility, reserve materials and other cellular inclusions; endospores and other persistent survival forms, pigments of bacteria and fungi.
c. Eukaryotic cell structure –
The compartmentalization of higher cells, the cytosol, the endoplasmic reticulum, the golgi apparatus, lysosomes and peroxisomes, organelles with double membranes – the nucleus,mitochondria and chloroplasts.

Unit 2: The Cytoskeleton
6

a. General features of mictotubles & actin filaments as dynamic assemblies
b. Microtubule organizing centers and microtubule associated proteins

c. Actin filaments & actin- binding proteins in nonmuscle cells
d. Intermediate filaments, organization of the cytoskeleton
e. Cilia & Flagella-Structure and Function
f. Microfilaments-Assembly and Disassembly
g. Muscle contractility

Unit 3: Cell adhesion and extra cellular matrix
5

Intercellular recognition and cell adhesion, cell junctions, the extracellular matrix.

Unit 4: Chemical signaling between cells
7

a. Molecular mechanism of signal transduction,
b. Ion gated channel:ligand gated ion chanel,
c. Neurotransmitters,
d. G-protein coupled receptor
e. Receptor enzymes.
f. Secondary messengers: cyclic AMP, calcium, Phosphatidylinositol

SECTION-II

Unit 1: Cell Cycle
10

a. Component of cell cycle control system,
b. Intracellular control of cell cycle,
c. Extracellular control of cell cycle,
d. Cell division: Mitosis and Meiosis

Unit 2: Cell Differentiation and the maintenance of tissues 8

a. Maintenance of the differentiated state
b. Tissues with permanent cells,
c. Renewal by simple duplication
d. Renewal by stem cells- epidermis
e. Renewal by pluripotent stem cells- blood cell formation

f. Quiescent stem cells – skeletal muscle
g. Stem cell engineering

Unit 3: Cellular aging and senescence
5

a. Cellular changes during aging:morphological changes
b. Physiological changes
c. Subcellular changes
d. Aging of cells in culture
e. Aging and organ system.
f. Theories of aging: neuroendocrine theory, Immune theory, somatic mutation theory, Glycation theory, error and fidelity theory, non genetic theory.

Unit 4: Cancer
7

a. Types of tumors
b. Molecular basis of cancer.
c. Somatic mutation: proto-oncogene activation e.g. erb-B, myc, ras,src,sis
d. Antioncogene inactivation e.g. Rb ,WT-1 p53,
e. Mechanism of proto-oncogene activation: point mutation,Gene rearrengment,Gene amplification, promoter insertion, enhancer insertion.
f. Viruses: oncogenic retroviruses, DNA oncogenic viruses, chemical carcinogens, ionizing radiation.
g. Characteristics of growing tumor cells: general and morphological changes, biochemical changes, Metastasis, Apoptosis.

.

Text Books:

1. Cell Biology – Roy S.C. and De Kalyan Kumar (New Central Book Agency
2. Cell Biology – Fundamantal and Application, - Gupta M.L. and Jangir M.L. (Agrobios)
3. Cell and Molecular biology, 8th Ed. – De Robertis E.D.P. and De Robertis, Jr. E.M.F. (Lippincott Williams & Wilkins)

Reference Books:

1. Molecular Biology of the Cell, 2nd Ed. – Alberts B. et al (Garland Publishing)
2. Molecular Cell Biology, 2nd Ed. – Lodish et.al
3. Cell & Molecular Biology-Concepts & experiments, 3rd ed.- Gerald Karp (John Wiley and sons. New York

List of Experiments:

1) Sterility of cell culture work environment
2) Isolation of cell organelles: nucleus, mitochondria, lysosomes.
3) Microtechnique
   i) Fixation of various animal tissues
   ii)Processing of the fixed tissues
4) Staining Nucleus by using basic dyes and Feulgen technique
5) Staining Mitochondria by Janus green B method (in bird, insect, oral smear)
6) Staining Lysosomes by acid phosphatase in leucocytes
7) Staining Golgi apparatus -(Demo)
8) Staining Cell membrane
9) Study of cell membrane permeability

10) Cryo-preservation
    a) Freezing
    b) Thawing
11) Preparation of laboratory media (cell culture)
12) Media formulation and preparation (cell culture)
13) Harvesting of cells:
    a) by scraping
    b) by trypsinization
14) Preparation of
    a. Meiosis in grasshopper testis/earthworm ovary (Demo)
    b. Mitosis in onion root tips/ tradentia flowers

Second Year Engineering: Semester-III

4. Macromolecules and Biomembranes

Teaching Scheme: Hrs
Examination Scheme: Marks
Lectures : 4
Theory : 100
Practicals : 2
Term Work : 25

Practical/oral : 25

SECTION - I

Unit 1. Amino acids and peptides 7

Structural features of amino acids; Classification of amino acids; Physical properties- Ionisation of amino acid in aqueous solutions, amino acids as ampholytes ; titration curve and electric charge, differences in acid –base properties, separation by electric charge; Peptides-biologically active peptides-bradikinin, oxytocin, thyrotropin, glutathione.

Unit 2. Proteins 8

Classification of protein, covalent structure of proteins, secondary structure-α helix, β-sheet, protein tertiary structure, quarternary structure. Conformational analysis of polypeptides and proteins. Ramachandran plot.Potential energy calculations for psi, phi angles. Predication of secondary structure- Chou-Fasman technique, Protein folding-chaperones. Protein-protein and protein-ligand interaction.

Unit 3. Carbohydrates
8
Monosaccharides, Disaccharides, Polysaccharides, proteoglycans, glycoproteins, glycol-structure and function. Commercially important carbohydrates-Cellulose, Xylan, Starch Fructan, Mannan, Pectin, Agar, Chitin, Lignin.

Unit 4. Lipids and fats
7
Classification of lipids-simple and complex lipids, structure and function of glycolipids, phospholipids, sphingolipids, sphingomyelin, lipoproteins

SECTION-II

Unit 1. Membrane structure and function
7
Functions, The chemical composition of membranes, Membrane fluidity, Artificial membrane model- Liposome.

Unit 2. Membrane transport of small molecules
9
Aquaphorins, Ionophores, Ion selective channel voltage gated e.g. Neuronal Na+ channel, Ligand gated channels e.g. Acetylcholine receptor, Plasma membrane involved in facilitated diffusion- glucose transporter, chloride transporter, Active transport- Na+ - K+ dependent ATPase, Ca+ dependent ATPase.

Unit 3. Membrane transport of macromolecules and particles- exocytosis and endocytosis
10 Exocytosis, Membrane fusion, Endocytosis, Coated pits and vesicles provide a specialized pathway for recepted mediated endocytosis of specific macromolecules, Many cell surface receptors associate with coated pits only after liagand binding, Some Macromolecules can penetrate cell membrane directly, Specialized phagocytic cells ingest particles that bind to specific receptors on their surface, Phagocytosis is a localized response that proceeds by a

"membrane-zippering", Membrane vesicular traffic – how it is powered, guided and regulated?

Unit 4. Membrane Receptors 4

Structures and functions, methods to study membrane receptors, purification and characterization of adrenergic and cholinergic receptors.

Text books

1. Text book of Biotechnology by H. K. Das.
2. Biochemistry by Lubert Stryer (Freeman Int. Edition)
3. U.Satyanarayan's Biochemistry 2nd Edition Uppala Publication
4. "Principles of Biochemistry" by Albert Lehninger (CBS Publishers)

Reference books

1. Vitamins and Hormones, vol. 54, 1st Edition by Gerald Litwack (Academic Press Publication)
2. Molecular Cell Biology, 2nd Edition,-Lodish et.al
3. Molecular Biology of the Cell, 2nd Edition-Bruce Alberts. Et. Al (Garland Publishing)

List of Experiments:

1. Preparation of standard solutions and buffers.
2. Verification of Beer-Lambart's law;determination of λmax of KMno4
3. Determination of total soluble sugars by ferricyanide method
4. Determination of reducing sugars by Nelson-Somogyi's method
5. Estimation of DNA by Diphenyl reaction
6. Determination of RNA by Orcinol Method
7. Estimation of proteins by Lowry's method
8. Determination of glycogen in liver
9. Separation of amino acids using TLC/Paper chromatography

10. Separation of sugars using TLC/Paper chromatography
11. Reactions of monosaccharides : Molisch Test, Benedict Test, Feling Test, Barfode Test
12. Reactions of disaccharide : Molisch Test, Benedict Test, Feling Test, Barfode Test, Seliwinoff's Test
13. Precipitation Reactions of Proteins : Precipitation by mineral acids, by alcohol, Heat co-agulation Test by ammonium sulphate, by heavy metals
14. Color reactions of proteins
    1.Biuret Test
    2 Ninhydrin Test
    3. Xanthoproteic Test
    4. Millon's Test
    5. Sakaguchi Test
    6. Hoffkin-Cole Test
    7. Sulphur / Lead acetate Test

Second Year Engineering: Semester-III

5. Unit Operations – I

Teaching Scheme: Hrs
Examination Scheme: Marks
Lectures : 3
Theory : 100
Practicals : 2
Term Work : 25

Practical : 25

SECTION- I

Unit 1. Fluid static's & its applications 5

Hydrostatic equilibrium, Barometric equation, Hydrostatic equilibrium in centrifugal field, applications- Manometer, continuous gravity decanter, centrifugal decanter.

Unit 2. Liquid flow phenomenon 5

Classification of fluids, Rheological behavior of fluids & fermentation broth, Newton's Law of viscosity. Effect of temperature & pressure on viscosity of fluids. Factors affecting broth viscosity. Types of flow & introduction to Reynolds No.

Unit 3. Basic equations of fluid flow 6

Continuity Equation, Bernoulli's equation, Laminar flow in pipes, Hagen paustulies equation, Turbulent flow in pipes, friction factor chart.

Unit 4. Fluid pumping & Metering 7

Flow measuring devices –Venturimeter, Orifice meter, Pittot tube, Rotameter, Classification of pumps - syringe pump, peristaltic pump, centrifugal pumps, fans, Blowers& Compressors, Types of valves.

SECTION- II

Unit 1. Properties & Handling of solids 4

Characterization of solid particles **–** Particle shape, Particle size & its analysis, mixing of solids-Ribbon mixer, pony mixer, beater mixer, kneaders & disperser blades.

Unit 2. Grinding & Mixing 4

Ball mill, fluid energy mill, Agitated mills & colloid mill, pulveriser, Agitated vessel & types of impellers, flow patterns, power required for agitation.

Unit3. Units and dimensions 6

Measurement conventions, density, specific gravity, specific volume, mole, chemical composition, temperature, pressure, standard conditions and ideal gases, ideal gas law, physical & chemical property data, Stoichiometry with suitable biochemical example.

Unit 4. Fundamental of material balance 8

Law of conservation of mass, types of material balance, procedure for material balance, calculation with suitable biochemical examples, material balance with recycle, bypass and purge system, Stoichiometry of growth and product formation, growth Stoichiometry & elemental balances, Electron balances, biomass yield, product Stoichiometry, Theoretical oxygen demand, maximum possible yield.

Text Books:

1) Unit operations of chemical Engineering – W.L. McCabe and J.M.Smith.
2) Bioprocess Engineering principles – Pauline M.Doran.

Reference Books-

1) Transport processes and separation process principles – Christic John Geankoplis.
2) Stoichiometry – By Hougen and Watson.
3) Chemical Engg Volume I – Richardson and coulson.

List of Experiments:

Experiments on following topics are to be conducted:-

1. Friction losses through pipes.
2. Venturimeter.
3. Orifice meter.
4. Bernoulli's experiment.
5. Ribbon blender.
6. Sieve analysis.

7. Ball mill.
8. Sedimentation.
9. Measurement of density for different liquid & solids, specific volume.
10. Assignment on material balance of any process.
11. Plate & Frame filter press.
12. Leaf filter.

Note: Any eight (8) experiments are to be conducted.

Second Year Engineering: Semester-III

6. Microbial Identification studies

Practical hours/week: 2
Term work: 25 marks

Students will be provided with unknown microbial culture. The student shall identify and characterize the given culture based on morphological, cultural and biochemical characteristics (using Bergey's Manual series) and submit report to the department on the work carried out throughout the semester. The term work marks shall be based on

1) The performance of the student
2) Report on work done
3) Questions and answers during report submission

The faculty member/members shall guide the students in:

1) Information retrieval (literature survey)

a. Source of information i.e. names of the books, journals, reports books etc.

b. Searching for the information i.e. referring to manuals etc.

2) Preparation of the protocol and work plan

3) Preparation of the report as per the guidelines of department.

4) The theoretical aspects of 16S rRNA technique and DNA-DNA hybridization technique and its application in microbial identification.

Second Year Engineering: Semester-III

7. Soft skills-I

Tutorial hours/week: 1
Term work: 25 marks

Personal Competences

Soft skills

Definition & importance, general types of soft skill (social, Psychological, Communication)

Personal Qualities

Introduction, components of personality, multitask handling, Administrative and technocratic qualities, introduction to personal evaluation and appraisal

Thinking skill

Importance of thinking, types of thinking,
Intelligence and emotional quotient

Leadership skills

Definition, types of leaderships, leadership styles

Time management

Importance & significance of time, utilization,

Business etiquettes

Introduction, importance, different types of etiquettes, manners, protocols, corporate culture

Stress management

Definition, types of stress, stress management,

Term work marks shall be based on-

Personality tests
IQ and EQ tests
Leadership essays

Time schedules of different organizations
Diversified culture
Brainstorming

Reference Books
Organizational Behavior by Don Hellriegel, Jhon W. Slocum, Richard W. Woodman

Second Year Engineering
SEMESTER– IV

Second Year Engineering: Semester-IV
1. Biostatistics

Teaching Scheme: Hrs
Examination Scheme: Marks
Lectures : 3
Theory : 100
Tutorial : 1
Term Work : 25

SECTION – I

Unit 1 Descriptive Statistics:
4

1.1 Presentation of Data : Frequency Distribution, Graphical presentation of data.
1.2 Measures of Location: Mean, Median, Mode and simple properties (Without derivation)
1.3 Measures of Dispersion: Range, Variance, Standard Deviation (S.D)

Coefficient of Variation.

Unit 2 Probability:
5

2.1 Statistical Probability with simple problems.
2.2 Conditional probability.
2.3 Baye's Theorem.

Unit 3 Probability Distribution
4

a. Discrete Distributions – Binomial, Poisson distribution and properties.
b. Continuous Distributions – Normal distribution and properties.

Unit 4: Test of Significance:
8

4.1 Sampling distribution of mean and standard error
4.2 Large sample tests (test for an assumed mean and equality of two population means)
4.3 small sample tests (t-test for an assumed mean and equality of means of two populations), Paired t-test.
4.4 Confidence Interval for means.

SECTION – II

Unit 1: Correlation and Regression:
6

1.1 Bivariate data – simple correlation and regression coefficients and their relation.
1.2 Linear regression and equations of line of regression.
1.3 Curve Fitting.
1.4 Logistic Regression.

Unit 2: Test using Chi-square Distribution:
5

2.1 Inference about population variance.
2.2 Goodness of fit test.

2.3 Test for independence of attributes Yates's Correction.

2.4 Confidence Interval for variances.

Unit 3: Experimental Design:
6

3.1 Principles of experimental designs, completely randomized design.

3.2 Randomized block design and precision of results.

3.3 Simple factorial experiments of 2^2, 2^3.

3.4 Analysis of variance (ANOVA) and its uses in the designs.

Unit 4: Sampling and Research Methodology:
4 4.1 Sampling Techniques –Simple random sampling, Systematic, Stratified
Multistage, Cluster sampling (Theoretical)

4.2 Designing and Methodology of an Experiment.

General Instructions:

1. For the term work of 25 marks, batch wise tutorials are to be conducted. The number of students per batch should be as per University pattern for practical batches.
2. Minimum number of assignments should be 8 covering all topics.
3. Use Statistical software to solve the real life and engineering problems.

Nature of Question paper:

1. There will be two sections carrying 50 marks each.
2. There will be four questions in each section and three question should be attempted from each section.

Reference Books:

1. Statistics and Experimental Design – An Introduction for Biologists and
Biochemists – Geoffrey Clark

2. Gupta S.C. Fundamentals of Statistics. Himalaya Publishing House, New Delhi.
3. Daniel W.W, Biostatistics: A Foundation for Analysis in the Health.
4. Introduction to Biostatistics and Research Methodology – Rao & Richard.
5. Mathematical Models in Biology – Allman & Rhodes.

Second Year Engineering: Semester-IV

2. Unit Operation – II

Teaching Scheme: Hrs
Examination Scheme: Marks
Lectures : 4
Theory : 100
Practical : 2
Term Work : 25

Practical/oral : 25

SECTION – I

Unit 1. Mechanism of heat transfer. Basic law of conduction, steady-state conduction combine resistances, combine conduction and convention. Heat flow through cylinder. **7**

Unit 2. Convection heat transfer, dimensional analysis, forced and natural convection, convention in flow over surfaces through pipes. Boiling and condensation. **7**

Unit 3. Heat exchangers 10

Types of heat exchanging Equipments, Double- pipe heat exchanger. Countercurrent and parallel flows heat flux and

overall and individual heat transfer coefficients. LMTD, fouling factor and typical overall heat transfer coefficient, extended surfaces.

Unit 4. Evaporation 6

Design of evaporators, overall heat transfer coefficients, calculation for single and multiple effects.

SECTION – II

Unit 1. Molecular diffusion 7

Diffusion theory, role of diffusion in Bioprocessing, film theory, oxygen uptake in cell culture, factors affecting cellular oxygen demand oxygen transfer from gas bubble to cell.

Unit 2. Distillation 9

Raoult's law, Ideal solutions types of distillation vapour liquid equilibria. McCabe Thiele method. Azeotrophic distillation, Total reflux, minimum and optimum, extractive distillation, reflux ratio, molecular distillation, vacuum distillation.

Unit 3. Drying 9

Classification of dryers, principles of drying, calculation of heat duty, rate of drying, Critical moisture content, calculation of drying time, drying equipments, freeze dryer, tray dryer, rotary dryer, fluidized bed dryer, spray dryer, drum dryer, flash dryer.

Unit 4. Extraction 5

Introduction to liquid-liquid extraction, Application of extraction to biological system, batch operation.

Text books:

1) Unit operations of Chemical Engg.-W. L. McCabe and J. M. Smith.
2) Bioprocess Engg. Principles- Pauline M.Doran.

Reference books:

1) Transport processes and separation processes principles- Christic John Geankoplis
2) Stoichiometry by Hougen and Watson.
3) Chemical Engg. Vol. 2. By Richardson & Coulson.

List of Experiments:

Experiments on following topics are to be conducted:-

1. Heat transfer in metal rod.
2. Heat transfer through insulating powder.
3. Double pipe heat exchanger.
4. Shell & tube heat exchanger.
5. Forced convection.
6. Natural convection.
7. Lagged pipe.
8. Simple distillation.
9. Vacuum distillation.
10. Vacuum dryer.
11. Rotary Dryer.
12. Extraction of solute.

Note: Any eight (8) experiments are to be conducted.

Second Year Engineering: Semester-IV

3. Enzyme Technology

Teaching Scheme: Hrs
Examination Scheme: Marks
Lectures : 4
Theory : 100
Practical : 2
Term Work : 25

Practical/oral : 25

SECTION- I

Unit 1. Enzymes
9

Classification, nomenclature, International units and types of enzymes, General characters of enzymes: characters such as specificity, catalysis and regulation and localization of enzymes in the cell, Structure of enzymes: Primary, secondary and tertiary structure of enzyme.

Unit 2. Enzyme Kinetics
7

Introduction to kinetics: activation energy, transition state theory and energy, consideration, Kinetics of single substrate enzyme catalysed reaction- Michaelis- Menten equation, Significance of Km and Vmax, Modifications of Michaeli's –Menten plot.

Unit 3. Enzyme inhibition and its kinetics
5 Types of inhibition- Reversible and irreversible inhibition, Kinetics of inhibition.

Unit 4. Enzyme Catalysis
9

Catalytic efficiency- proximity and orientation effects, distortion or strain, Different mechanisms of enzyme catalysis, acidbase and covalent catalysis and metal-ion catalysis, Molecular mechanism of action of chymotrypsin, Lysozyme, Chemical modification of enzymes

SECTION- II

Unit 1. Allosteric and regulatory enzyme
7

Binding of ligands to Protein, Co-operativity models- MWC and KNF model, Regulations by allosteric enzymes, Other

mechanisms of enzyme regulation-enzyme induction and repression and covalent modification.

Unit 2. Immobilized enzymes 6

Methods of immobilization - ionic bonding, adsorption, covalent, bonding (based on R groups of amino acids), microencapsulation and gel entrapment, Properties of immobilized enzymes, Applications of immobilized enzymes.

Unit 3. Production of enzymes 10

Sources of enzymes-animal plant and microbial sources, Large scale production of enzymes- basic methodology of production, extraction and purification of enzymes, Enzyme production and recombinant DNA technology.

Unit 4. Biotechnological applications of enzymes 7

Applications of enzymes in food, sugar, leather, detergent industries etc., Uses of enzymes in drug, medicine, industries, Uses of enzymes to make amino acids and peptides, Legislative and safety aspects.

Text Books:

A text book of Biochemistry,-A.V.S.S. Rama Rao 9th ed (UBS Publisher's and Distributors Pvt. Ltd.)

Leninger: Principles of Biochemistry, 3rd Ed.-Nelson D. et al (Worth Publishers)

Basic Biotechnology, 2nd Ed.-Ratledge, C and Kristiansen B. (Cambridge).

Reference Books:

Fundamentals of Enzymology Price and Stevens

Enzymes Dixon and Webb

Isoenzymes By D. W. Moss

Immobilized Biocatalysts W. Hartneir

Selected papers Allosteric Regulation M. Tokushige

Biochemistry, 5th, Ed.Berg,J.M. Tymoczko J.L. and Stryer L. (W.H. Freman & Co.)
Molecular biology of the Cell,2nd Ed.- Alberts B. et al (Garland Publishing)
Molecula cell biology, 2nd Ed.- Lodish et al.

List of Experiments:

1. Isolation of amylase, protease and cellulase producing microorganisms.
2. Qualitative detection of enzymes-
   a) Amylase
   b) Cellulase
   c) Urease
   d) Catalase
   e) Invertase
3. Assay of enzyme (Amylase/ Invertase)
4. Effect of variables on enzyme activity- amylase/invertase
   a. Substrate concentration
   b. Temperature
   c. pH
5. Effect of inducers and inhibitors on amylase/ invertase
6. Study of Immobilization by whole cell entrapment method (Demo).

Second Year Engineering: Semester-IV

4. Metabolic Pathways and Their Regulation

Teaching Scheme: Hrs
Examination Scheme: Marks
Lectures : 3
Theory : 100
Practical : 2
Term Work : 25

Practical/oral : 25

SECTION –I

Unit 1. Metabolism of carbohydrates

8

Glycogenolysis, Glycogenesis, Glycolysis, TCA cycle, HMPshunt pathway, Pentose phosphate pathway, Gluconeogenesis, Fermentation.

Unit 2. Metabolism of lipids

5

α, β, ώ oxidation of saturated and unsaturated fatty acid, propionate pathway, Biosynthesis of Lipids and cholesterol

Unit 3. Metabolism of Proteins

5

Transamination of amino acids, Deamination of amino acids, urea cycle. Biosynthesis of amino acids, Biosynthesis of proteins.

Unit 4. Metabolism of nucleic acids

5

Biosynthesis of purines and pyraimidines, catabolism of purines and pyramidines

SECTION- II

Unit 1. Biological oxidation

7

Enzymes of biological oxidation, High energy compounds – ATP, ADP. Electron transport chain, oxidative phosphorylation, pigments involved in photosysnthesis

Unit 2. Electron transport under anaerobic condition:

7

Nitrate respiration-denitrification and nitrate amonification, Denitrification, Reduction of sulphur to hydrogen sulphide, the formation of methane by reduction of carbonate, the formation of acetate by reduction of carbonate, the formation of succinate by reduction of fumerate,reduction of iron (III) to iron (II) ions.

Unit 3. Inorganic hydrogen donors

4

Aerobic chemolithotropic bacteria, Ammonium and nitrite oxidation, nitrification, oxidation of reduced sulphur compounds, oxidation of iron (III), oxidation of molecular hydrogen, carbondioxide fixation.

Unit 4. Stoichiometric and kinetics of microbial growth from a thermodynamic perspective

4

Nomenclature, Introduction, Stoichiometric calculations, Stoichiometric prediction based on Gibbs Energy dissipation, growth kinetics from a thermodynamic point of view

Text books

1. Topley and Wilson's Microbiology and Microbial infections 9th Edn vol 5 –Cox F.E.G. et al (Arnold publication)
2. U. Satyanarayana's Biochemistry 2nd Edn (Uppala Publication)
3. General Microbiology 7th Edn. Schlegel H.G (Cambridge University Press)

Reference books

1. Molecular Biology of the Cell , 2nd Edn.- Albert Bruce (garland Publication)
2. Molecular Cell Biology, 2nd Edn Lodish et al
3. Biochemistry by Stryer

List of Experiments:

1. Estimation of serum creatinine by Jaffe's Method.
2. Estimation of serum Albumin by Bromocresol dye method.
3. Estimation of serum Bilirubin-Direct and Indirect by Malloy and Evelyn method.
4. Estimation of serum Triglcerides.
5. Estimation of serum SGOT.
6. Estimation of serum SGPT.
7. Estimation of serum alkaline phosphatase.

8. Estimation of serum cholesterol.
9. Column chromatographic separation of proteins by Gel filtration.
10. Separation of proteins by polyacrylamide gel electrophoresis.

Second Year Engineering: Semester-IV

5. Molecular Biology

Teaching Scheme: Hrs
Examination Scheme: Marks
Lectures : 4
Theory : 100
Practical : 4
Term Work : 25

Practical/oral : 50

SECTION –I

Unit 1. Genetic material
4

a) Evidences for nucleic acids as genetic material
b) Watson and Crick's model of DNA structure
c) Alternative forms of DNA.

Unit 2. Organization of genetic material
14

a) Viruses: Nature of genetic material, unfolding and packing of viral genetic material.
b) Bacteria: Folded fibre model in *E. coli.*
c) Eucaryotes: Nucleus, nucleosomes, Euchromatin and heterochromatin, histones and non histone proteins, Giant chromosomes, satellite DNA. Structure of class I, class II and class III genes.

d) Split genes and overlapping genes.

Unit 3. Duplication of chromosome and DNA 9

a) DNA replication in *E. coli*- rules and enzymes involved theta and rolling circle model.
b) Nucleic acid replications in viruses: basic model- rolling circle, theta and linear DNA replication.
c) Organelle DNA replication – chloroplasts and mitochondria.
d) Chromosome duplication – Taylor's experiment, Dupra's folded fibre and alternative folded fibre models of metaphase chromosomes.
e) RNA replication.

Unit 4. Plasmids 3

Nomenclature and classification; general properties and types; detection and purification; replication and transfer processes.

SECTION -II

Unit 1. Molecular aspects of gene regulation and expression 15

a) Evolution of one cistron one polypeptide theory.
b) Genetic code-Deciphering of genetic code, Dictionary and important properties of genetic code.
c) Transcription in prokaryotes and eukaryotes, RNA processing, structures of rRNA, tRNA and mRNA, antisense RNA and its significance, post-transcriptional processes, Novel structural motifs in transcription factors in eukaryotes.
d) Translation in prokaryotes and eukaryotes, operon models-lactose, tryptophan and arabinose, Post-translational modifications, fate of newly synthesized proteins.
e) Environmental factors in gene expression.
f) Inhibitors of transcription and translation.
g) Regulation of gene expression.

h) Global influences on gene expression.

Unit 2. DNA damage and repair 5

Types of damages, damaging agents, repair mechanisms - photoreactivation, dark repair, postreplicational recombination repair, SOS repair.

Unit 3. DNA recombination 4

Homologous recombination, Site-specific recombination, Consequences of recombination event.

Unit 4. Mobile elements in prokaryotes and eukaryotes 6

Discovery, Characteristics of transposable elements, Types: insertion sequences, transposons, Retrosposons, Maize transposons, Ty elements of yeast, Transposition- replicative and non-replicative, formation of target site duplications.

Text books:

1. Genes VII – Benjamin Lewin
2. Molecular Biology – Freifelder
3. Molecular Biology and biotechnology, 4th ed by Walker J.M. and Rapley R.
4. Molecular Biology of the genes – Watson J.D.
5. Principles of Genetics - Gardner E.J. Simmons M.J. and Slustad D.P.
6. Genetics – Monroe W. and Strickberger

Reference books:

The Cell - Bruce Alberts et al
Molecular Biology of cell – Lodish et al
Genes and Genomes – Singer M and Berg P.

List of Experiments:

1. Demonstration of bacterial and yeast DNA.
2. Spooling of chromosomal DNA from onion cells.

3. Isolation of DNA from bacteria and yeasts.
4. Isolation of RNA from yeasts.
5. Isolation of bacterial plasmid.
6. Isolation of yeast plasmid.
7. Principles and practice of agarose gel electrophoresis.
8. Quantitation of DNA.
9. Isolation of restriction endonucleases from bacteria.
10. Testing of chemicals for mutagenecity using Ame's test.
11. Determination of melting temperature (Tm) and base composition of DNA from thermal denaturation characteristics.
12. Isolation of plant mitochondrial DNA.
13. In vitro transcription.
14. Purification of plasmid.
15. Tunel technique- DNA repair.
16. Bacterial conjugation.

Second Year Engineering: Semester-IV

6. Basic computer language skills

Practical hours/week: 2
Term work: 25 marks

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1. MS-Window Operating System

a. Introduction
b. System Requirements
c. Installation (Microsoft XP and Microsoft Server2000)
d. Security Features, Administrator Privileges
e. Authentication, User account creation

2. Unix Operating System

a. Introduction to Unix
b. Installation of RedHat Linux, or Fedora Core or Ubuntu
c. Terminal Commands, VI-Editor
d. Shell Commands and Scripts
e. Open Office

3. C, C^{++}, Oracle, Visual basic, dotnet

4. Internet and Web Browsing

a. Internet Explore, Mozilla Fire Fox
b. Biological Search Engines- SRS, Entrez
c. Protein Data Bank and Structural analysis
d. Visualization tools- RasMol, SwissPDB, Cn3D
e. Literature Databases- PubMed, Medline, Scirus, Nature

Second Year Engineering: Semester-IV

7. Soft skills-II

Tutorial hours/week: 1
Term work: 25 marks

Corporate Culture and Team Work

Communication skills-

Oral/spoken, written communication skills, effective presentation skill

Interpersonal skills-

Definition, significance, different types of interpersonal skills

Teamwork/collaboration skills –

Basic types of team, team effectiveness factors

Problem-solving skills –

Introduction, Different steps in problem solving, barriers in problem solving,
Decision making,

Work ethic -

Definition of profession, Importance of values, types of management's ethics, work attitude

Conflict management-

Definition, varieties of conflicts, negotiation

Self evaluation and appraisal

Importance and significance, parameters of evaluation and appraisal

Term work marks shall be based on-

Technical Presentation
Team work- case study

Corporate meeting
Case study of corporate problem
Self evaluation

Reference Books

Organizational Behavior by Don Hellriegel, Jhon W. Slocum, Richard W. Woodman

Equivalence of subject of S. E. Part I & II [Biotechnology] under the Faculty of Engineering and Technology

Part I

Sr.No.	S.E. Part I Pre-revised	S.E. Part I Revised
1	Molecular Basis of Life	Molecular Biology
2	Cell Biology	Cell Biology
3	Microbiology-I	Microbiology
4	Applied Mathematics	Engineering Mathematics-III

Part II

Sr.No.	S.E. Part II Pre-revised	S.E. Part II Revised
1	Macromolecules	Macromolecules and Biomembranes
2	Biomembranes	Macromolecules and Biomembranes
3	Microbiology-II	Metabolic Pathways and Their Regulation
4	Enzyme Technology	Enzyme Technology

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An academic term (or simply term) is a portion of an academic year, the time during which an educational institution holds classes. The schedules adopted vary widely. In most countries, the academic year begins in late summer or early autumn and ends during the following spring or summer. In Northern Hemisphere countries, this means that the academic year lasts from August, September, or October to May, June, or July. In Southern Hemisphere countries, the academic year aligns with the calendar year