MAHARSHI DAYANAND UNIVERSITY, ROHTAK

Scheme of Examination for Semester III

B.Tech. 2nd YEAR (SEMESTER – III) (CHEMICAL ENGINEERING)

S. No.	Category Course notation	Course Code	Course Title	Teaching Schedule			Marks of Class work	Examination Marks		Total	Credit	Duration of Exam
				L	T	P		Theory	Practical			
1	ESC	ESC-CHE201-G	MATERIALS SCIENCE	3	-	-	25	75	-	100	3	3
2	ESC	ESC-CHE203-G	BASIC THERMODYNAMICS	3	1	-	25	75	-	100	4	3
3	PCC	PCC-CHE205-G	MATERIAL & ENERGY BALANCE COMPUTATIONS	3	1	-	25	75	-	100	4	3
4	PCC	PCC-CHE207-G	FLUID FLOW	3	1	-	25	75	-	100	4	3
5	PCC	PCC-CHE-221-G	ENGINEERING AND SOLID MECHANICS	3	1	-	25	75	-	100	4	3
6	BSC	BSC-CHE-201-G	ORGANIC REACTION MECHANISM	3	-	-	25	75	-	100	3	3
7	PCC	LC-CHE-209-G	FLUID FLOW LAB	-	-	2	25	-	25	50	1	3
8	MC	MC-106- G	ENVIRONMENT STCIENCE	3	-	-	-	-	-	-	-	3
			TOTAL	**21**	**4**	**3**	**175**	**450**	**25**	**650**	**23**	

BSC – Basic Science courses

ESC – Engineering Science Courses

MC – Mandatory non-credit Courses

PCC – Professional Core Courses

NOTE-

*__MC-106G__is a mandatory non –credit course in which the students will be required passing marks in theory.

MAHARSHI DAYANAND UNIVERSITY, ROHTAK

Scheme of Examination for Semester IV

B.Tech. 2nd YEAR (SEMESTER – IV) (CHEMICAL ENGINEERING)

S. No.	Category	Course No.	Course Title	Teaching Schedule			Marks of Class work	Examination Marks		Total	Credit	Duration of Exam
				L	T	P		Theory	Practical			
1	PCC	PCC-CHE-202-G	CHEMICAL ENINEERING THERMODYNAMICS	3	-	-	25	75	-	100	3	3
2	PCC	PCC-CHE-204-G	NUMERICAL METHODS IN CHEMICAL ENGINEERING	3	1	-	25	75	-	100	4	3
3	PCC	PCC-CHE-206-G	PARTICLE & FLUID PARTICLE PROCESSING	3	-	-	25	75	-	100	3	3
4	PCC	PCC-CHE-208-G	HEAT TRANSFER	3	1	-	25	75	-	100	4	3
5	HSMC	HSMC-201-G	ECONOMICS FOR ENGINEERING	3	-	-	25	75	-	100	3	3
6	BSC	BSC-BIO-205-G	BIOLOGY	3	-	-	25	75	-	100	3	3
7	PCC	LC-CHE-210-G	NUMERICAL METHODS IN CHEMICAL ENGINEERING LAB			2	25	-	25	50	1	3
8	PCC	LC-CHE-212-G	MECHANICAL OPERATIONS LAB	-	-	2	25	-	25	50	1	
9	PCC	LC-CHE214-G	HEAT TRANSFER LAB	-	-	2	25	-	25	50	1	3
10	MC	MC-317-G	CONSTITUTION OF INDIA				GRADE	**Refer Note -1**				
TOTAL				**21**	**2**	**6**	**225**	**450**	**75**	**750**	**23**	

BSC – Basic Science courses
HSMC – Humanities and Social sciences including Management courses
MC – Mandatory non-credit Courses
PCC – Professional Core Courses

Note:

1. The evaluation of “Constitution of India” will be according to performance of the students based on Class work/Assignments and awarded grades A, B, C, F. A student who is awarded ‘F’ grade is required to repeat the Subject. a. Excellent: A; Good : B; Satisfactory: C; Not Satisfactory: F.

2. Each student has to undergo practical training of 4 weeks during summer vacation after 4th semester and its evaluation shall be carried out in 5th Semester.

B. Tech. Semester - III (Chemical Engineering)							
ESC-CHE-201-G : MATERIALS SCIENCE							
L	**T**	**P**	**Credits**		**Class Work**	**:**	**25 Marks**
3	**0**	**-**	**3**		**Examination**	**:**	**75 Marks**
					Total	**:**	**100 Marks**
					Duration of Examination	**:**	**3 Hours**

Course Objectives: Basic introduction to the different classes of materials relevant to engineering in general, and Chemical Engineering in particular. The intent of the course will be to relate the underlying molecular structure of the materials to their physical and chemical properties, and their processing and performance characteristics. .

Course outcomes:

1. Students will demonstrate understanding of the fundamental structure and bonding of key materials like metals, ceramics, polymers and composites. (K2 - Understanding)
2. Students will be able to explain how microstructure and defects in materials affect their mechanical, electrical, thermal and optical properties. (K2 - Understanding)
3. Students will be able to select appropriate materials and processing methods for engineering applications based on analysis of structure-property relationships. (K3 - Applying)
4. Students will gain hands-on experience characterizing materials using techniques like optical microscopy, tensile/hardness testing, DSC, XRD, etc. (K3 - Applying).

Syllabus contents:

UNIT-I: Introduction to materials, bonding between atoms: metallic bonding, ionic bonding, covalent bonding, Van der Waals bond, thermal expansion, elastic modulus and melting point of materials, Factors affecting the selection of material for constructional purposes in chemical industries, Metallic and Non-Metallic materials of construction, Ferrous and Non-Ferrous metals. Role of materials selection in design, structure-property-processing-performance relationships. Corrosion, Various types, Mechanism, Methods of prevention and control. (11 contact hrs.)

UNIT-II: Miller indices of directions and planes, packing of atoms inside solids, close-packed structures, structure of ceramics, ionic solids, glass and polymers, density of various materials. Imperfections in solids: vacancies, equilibrium concentration of vacancies, interstitial and substitutional impurities in solids, dislocations, types and characteristics of dislocations, interfacial defects, stacking faults. Structure of materials and Strength of Materials: Yield strength, tensile strength and ductility of materials: stress strain behaviour of metals, ceramics and polymers, tensile test, plastic deformation, necking, creep behaviour and fatigue (12 contact hrs.)

UNIT-III: Semi-crystalline materials: Classification, structure and configuration of ceramics, polymers, copolymers, liquid crystals and amphiphiles. Non-crystalline/amorphous materials: Silicates, glass transition temperature, viscoelasticity. Polymer nano-composite materials: Nanocomposites, role of reinforcement-matrix interface strength on composite behavior. Engineering applications of different materials. (11 contact hrs.)

UNIT-IV: Biomaterials, material related to catalyst such as zeolites, silica etc. and other selected materials. Degradation and Recycling of materials.Introduction to experimental techniques: XRD, FTIR, NMR, PSA, etc. for material characterization highlighting links between molecular structure and macroscopic properties (11 contact hrs.)

TEXT BOOKS:

1. V. Raghavan Materials Science and Engineering: A First Course, 5th Edition Prentice Hall India, 2004.

2. S. Upadhyaya and A. Upadhyaya, Material Science and Engineering, Anshan Publications, 2007.

3. K.M. Gupta , Material Science and Engineering, Umesh Publication

REFERENCE BOOKS:

1. R. A. L Jones, Soft Condensed Matter, Oxford University Press, 2002.

2. William D. Callister, David G. Rethwisch Materials Science and Engineering: An Introduction, Wiley Publisher.

3. B. S. Mitchell An Introduction to Materials Engineering and Science for Chemical and Materials Engineers, John Wiley & Sons, 2004.

Note:

1. In Semester Examinations, the examiner will set two questions from each unit (total 8 questions in all) covering the entire syllabus. The students will be required to attend only five questions selecting atleast one question from each unit.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

For student admitted in B. Tech. 1st Year (C-Scheme) in 2019 and all trailing students.

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B. Tech. Semester - III (Chemical Engineering) ESC-CHE-203-G : BASIC THERMODYNAMICS							
L	**T**	**P**	**Credits**		**Class Work**	**:**	**25 Marks**
3	**1**	**-**	**4**		**Examination**	**:**	**75 Marks**
					Total	**:**	**100 Marks**
					Duration of Examination	**:**	**3 Hours**

Course Objectives: Principles and application of first and second law of thermodynamics, and phase equilibria.

Course Outcomes: Students will be able to

CO1: Ability to apply the energy balance with heat and work interactions to the thermodynamic systems and evaluate the properties of non-ideal gases

CO2: Ability to apply heat effects and concept of entropy to the thermodynamic systems.

CO3: Ability to evaluate changes in thermodynamic properties of substances and application of thermodynamics to flow processes

CO4: Ability to Solve problems involving liquefaction, refrigeration, different power cycles etc.

Syllabus contents:

UNIT-I: Introduction- scope of thermodynamics, Dimensions and Units, Temperature, Pressure, Work, Energy, Heat, enthalpy, Energy conservation & first law of thermodynamics, equilibrium, phase rule, heat capacity, ideal gas, real gas, heat effects, P-V-T Behaviour of Pure Fluids, Mass and energy balances for open systems, Virial equations, cubic equations, Reduced conditions & corresponding states theories; correlations in description of material properties and behavior

UNIT-II: Heat effects-latent heat, sensible heat, standard heats of formation, reaction and combustion, Statements of the second law; Heat engines, Carnot's theorem,; Thermodynamic Temperature Scales; Entropy; Entropy changes of an ideal gas; Mathematical statement of the second law; Entropy balance for open systems; Calculation of ideal work, Lost work.

UNIT-III: Thermodynamic property of fluids, Maxwell relations, 2-phase systems, graphs and tables of thermodynamic properties, Application of thermodynamics to flow processes-pumps, compressors and turbines

UNIT-IV: Thermodynamic analysis of steam power plants; Rankine cycle; Internal combustion engine, Otto engine; Diesel engine; Jet engine, The Carnot refrigerator; Vapor-compression cycle; Absorption refrigeration; Heat pump, Liquefaction processes..

TEXT BOOKS:

1. J.M. Smith, H.C. Van Ness and M.M. Abbott, Introduction to Chemical Engineering Thermodynamics, 7th edition, McGraw-Hill International Edition,2005. 2. Mass Transfer Operations: R.E. Treybal 3rd edition Mcgraw-Hill Book Company New Delhi..
2. Y.V.C. Rao, Chemical Engineering Thermodynamics: Universities Press (India) Ltd., Hyderabad, India

REFERENCE BOOKS:

1. M J Moran, H N Shapiro, D DBoettner and M B Bailey, Principles of Engineering Thermodynamics, 8th Edition, Willey
2. Chemical and Process Thermodynamics: B.G. Kyle - Prentice Hall of India Pvt. Ltd., New Delhi.

Note:

1. In Semester Examinations, the examiner will set two questions from each unit (total 8 questions in all) covering the entire syllabus. The students will be required to attend only five questions selecting atleast one question from each unit.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

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B. Tech. Semester - III (Chemical Engineering)							
PCC-CHE-205-G: MATERIAL & ENERGY BALANCE COMPUTATIONS							
L	**T**	**P**	**Credits**		**Class Work**	**:**	**25 Marks**
3	**1**	**-**	**4**		**Examination**	**:**	**75 Marks**
					Total	**:**	**100 Marks**
					Duration of Examination	**:**	**3 Hours**

Course Objectives:

The course will serve as a basis for all further chemical engineering courses that are part of the curriculum**.**

Course Outcomes:

1. Ability to learn basis of calculations in MEBC and enthalpy changes.
2. Ability to solve MB problems without chemical reactions
3. To learn Material Balance with recycle, bypass and purge.
4. To learn equation of state and properties of gases and liquids

Syllabus contents:

UNIT-I: Introductory concepts of units, physical quantities in chemical engineering, dimensionless groups,"basis" of calculations.Gases, Vapours and Liquids: Equations of state, Vapour pressure, Clausius-Clapeyron equation, Cox chart, Duhring's plot, Raoult's law.

UNIT-II: Material Balance: Introduction, solving material balance problems without chemical reaction**.** Material Balance: With chemical reaction, Concept of stoichiometry and mole balances, examples,including combustion

Material Balances with recycle, bypass and purge.

UNIT-III: Crystallization, Dissolution.Humidity and Saturation, humid heat, humid volume, dew point, humidity chart and its use.

UNIT-IV: Energy balance: open and closed system, heat capacity, calculation of enthalpy changes. Energy balances with chemical reaction: Heat of reaction, Heat of combustion

TEXT BOOKS:

1. Himmelblau, D. M., Riggs, J. B. "Basic Principles and Calculations in Chemical Engineering", Eighth Ed., Pearson India Education Services, 2015.
2. Bhatt, B. I., Vora, S. M., "Stoichiometry", Fourth Edition, Tata McGraw Hill Publishing Company Ltd, 2004.
3. Felder, R. M.; Rousseau, R. W., "Elementary Principles of Chemical Processes", Third Edition, John Wiley & Sons, 2000

REFERENCE BOOKS:

1. Hougen, O. A., Watson, K. M., Ragatz, R. A., "Chemical Process Principles, Part-I Material & Energy Balances", Second Edition, CBS Publishers & Distributors, 2004.

2. Venkataramani, V., Anantharaman, N., Begum, K. M. MeeraSheriffa, "Process Calculations", Second Edition, Prentice Hall of India.
3. Sikdar, D. C., "Chemical Process Calculations", Prentice Hall of India.

Note:

1. In Semester Examinations, the examiner will set two questions from each unit (total 8 questions in all) covering the entire syllabus. The students will be required to attend only five questions selecting atleast one question from each unit.
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B. Tech. Semester - III (Chemical Engineering) PCC-CHE-207-G : FLUID FLOW							
L	**T**	**P**	**Credits**		**Class Work**	**:**	**25 Marks**
3	**1**	**-**	**4**		**Examination**	**:**	**75 Marks**
					Total	**:**	**100 Marks**
					Duration of Examination	**:**	**3 Hours**

Course Objectives: The objective of this course is to introduce the mechanics of fluids (fluid statics and fluid dynamics), relevant to Chemical Engineering operations.

Course Outcomes:

1: Ability to understand forces on fluids, hydrostatic forces on submerged bodies, properties of fluids, kinematics of fluid flow.

2: Ability to apply Eulerian and lagrangian descriptions of flow, integral analysis involving mass & momentum balances, visualization of flow

3: Ability to measure flow, understanding of instruments, Bernoulli equation, flow transportation pumps, blowers,compressor,navierstokesequation,viscousflows,boundarylayertheory,turbulence,lubrication approximation

4: Ability to develop velocity profiles by simplification of equation of motion in simple 1-D flows to calculate friction factor, pressure drop, power requirements in single phase flow in pipes, two phases gas/liquid pressure drop, power requirements NPSH requirement of pump

Syllabus contents:

UNIT-I: Introduction to fluids, Continuum hypothesis, Forces on fluids, Normal and shear stresses Fluid statics - pressure distribution, Manometry, Forces on submerged bodies (planar and curved), Buoyancy, Rigid body motion (translation and rotation). Kinematics of fluid flow-Eulerian and Lagrangian descriptions, Flow visualization, Stream function, Vorticity and Circulation, Kinematic decomposition of flow motion

UNIT-II: System and control volume approaches, Reynolds transport theorem, Integral balances - mass and momentum, Euler's equation of motion, Bernoulli equation and applications, Turbulent flow, Head loss in pipe flow, Moody diagram. Flow measurement, Transportation of fluids - pumps, selection and design of pumps.

UNIT-III: Differential analysis: mass and momentum balances, Navier-Stokes equation, Unidirectional flow, Viscous flow, Stokes law, Skin drag and pressure drag. Potential flow, Potential function, Solution of Laplace equation. Boundary layer theory, Blasius solution, Boundary layer separation, Drag and lift force on immersed body.

UNIT-IV: Similitude analysis, Lubrication approximation. Compressible flows, Blowers and compressors. Introduction to turbulence: Structure of turbulence, visualization of turbulence, Reynolds decomposition, Spectral nature of turbulence and Kolmogorov hypothesis.

TEXT BOOKS:

1. M. White, Fluid Mechanics, 8th Edition, Tata-McGraw Hill, 2016.
2. V. Gupta and S. K. Gupta, Fundamentals of Fluid Mechanics, 2nd Edition, New Age International 2011.
3. W. L. McCabe, J. C. Smith and P. Harriot, Unit Operations of Chemical Engineering, 7th
4. Edition, McGraw-Hill International Edition 2005.
5. O. Wilkes, Fluid Mechanics for Chemical Engineers, Prentice Hall of India, 2005.
6. R. W. Fox, P. J. Pritchard and A. T. McDonald, Introduction to Fluid Mechanics, 7th Edition, Wiley-India 2010.

7. R. Welty, C. E. Wicks, R. E. Wilson, G. Rorrer, Fundamentals of Momentum, Heat and Mass Transfer, 4th Ed., Wiley (2007).

REFERENCE BOOKS:

1. B.R. Munson, D.F. Young, T.H. Okiishi and W. W. Huebsch, 6th Edition, Wiley-India 2010.
2. R.L. Panton, Incompressible Flow, 3rd Edition, Wiley-India 2005.
3. R.B. Bird, W. E. Stewart and E. N. Lightfoot, Transport Phenomena, 2nd Edition, Wiley-India

Note:

1. In Semester Examinations, the examiner will set two questions from each unit (total 8 questions in all) covering the entire syllabus. The students will be required to attend only five questions selecting atleast one question from each unit.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

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B.Tech. Semester-III (Chemical Engineering)

PCC-CHE-221-G : ENGINEERING AND SOLID MECHANICS

L	T	P	Credits			
3	1	-	4	**Class Work**	:	**25 Marks**
				Examination	:	**75 Marks**
				Total	:	**100 Marks**
				Duration of Examination	:	**3 hours**

Course Objectives:

Students would be introduced to fundamentals of Engineering Mechanics with emphasis on force systems, axioms, dynamics of rigid bodies. Second part of the course would be an introduction to Solid Mechanics, and students would be introduced to basic concepts of mechanics of deformable media: concept of stress tensor, strain tensor, strain rates, constitutive relations, and applications to one/two dimensional problems.

Course Outcomes:

Students will be able to

1. Understand the use of basic concepts of Resolution and composition of forces
2. Analyse beams, truss or any engineering component by applying conditions of equilibrium
3. List advantages and disadvantages of various geometric sections used in engineering design
4. Understand the different stresses and strains occurring in components of structure
5. Calculate the deformations such as axial, normal deflections under different loading conditions

Syllabus Contents:

UNIT – I: **Introduction:** Point Kinematics: Moving point in various coordinate systems (Cartesian, Cylindrical, Path)

Rigid body kinematics: Relative motion, angular velocity, General motion of a rigid body, General relative motion

UNIT – II: **Equivalent force systems:** Resultant forces, Linear and Angular Momentum, Laws of motion (Euler's Axioms), Free Body Diagrams, Dynamics of point mass models of bodies.

Kinematic of Rigid Bodies: Equilibrium of rigid bodies, Distributed forces, Brief introduction to structures: Trusses, Forces in Beams: Shear Force and Bending Moment

UNIT – III: **Friction:** Frictional forces, Laws of Coulomb friction, impending motion

Introduction to Vector and Tensor: A brief introduction to inertia tensor, Principal Moments of Inertia, Moment of momentum relations for rigid bodies, Euler's equation of Motion

UNIT – IV: **Stress and strain:** State of stress at a point, Concept of strain, strain displacement relations, compatibility conditions, Uniaxial stress and strain analysis of bars, thermal stresses, principal stress, maximum shear stress principal strains, transformation of stress/strain tensor.

Torsion of circular bars and thin walled members, Bending of straight beams, transverse shear stresses, deflection of cantilever and simply supported beams, Buckling of columns: Column under axial load, concept of instability and buckling, slenderness ratio, Euler's formulae for the elastic buckling load

TEXT BOOKS:

1. Engineering Mechanics- Statics and Dynamics by R. C. Hibler, Pearson
2. Engineering Mechanics - Statics & Dynamics by I.H. Shames, PHI, New Delhi.
3. Strength of Materials – G. H. Ryder - Macmillan, India
4. Strength of Materials– Andrew Pytel and Fredinand L. Singer, Addison – Wesley

REFERENCE BOOKS:

1. Strength of Materials – Popov, PHI, New Delhi.
2. Strength of Materials - A Rudimentary Approach – M.A. Jayaram, Sapna Book House, Bangalore
3. Mechanics of Materials - Timoshenko, S.P., and Gere, J.M., 2nd Ed., CBS Publishers 2002
4. An Introduction to the Mechanics of Solids - Crandall, S.H., Dahl, N.C., and Lardner, T.J., Tata McGraw-Hill 1999.
5. Statics & Dynamics by J.L. Meriam, JohnWiley& Sons (P) Ltd. New York.
6. Statics & Dynamics by Beer & Johnson, MGH, New Delhi.

Note:

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B.Tech. Semester-III (Chemical Engineering)

BSC-CHE-201-G : ORGANIC REACTION MECHANISM

L	T	P	Credits			
3	-	-	3	**Class Work**	:	**25 Marks**
				Examination	:	**75 Marks**
				Total	:	**100 Marks**
				Duration of Examination	:	**3 hours**

Course Objectives:

Students shall study concepts related to mechanism of industrially important reactions

Course Outcomes:

Students taking the course will:

- Get a better understanding of principles of organic chemistry
- Be able to predict reactivity pattern and propose reasonable mechanism

Syllabus Contents:

UNIT-I: **Mechanism of organic reactions:** Introduction, electron displacement effect, reactive intermediates; Types of organic reactions- substitution reaction, addition reaction, elimination reaction, rearrangement reaction; Types of mechanism-Free radical mechanism, Ionic mechanism.

UNIT-II: **Mechanisms and recent advances of following industrially important reactions:** Alkylation and acylation reactions- alkylation of benzene, phenol etc. Halogenation reaction- chlorination of toluene; Nitration and sulfonation reactions- nitration and sulfonation of benzene etc.

UNIT-III: **Mechanisms and recent advances of following processes:** Hydrogenation and reductive alkylations reactions- hydrogenation of nitrobenzene, reductive alkylation reactions of anilines, etc. Oxidation reactions- oxidation of xylenes etc.

UNIT-IV: **Mechanisms and recent advances of following processes:** Polymerization reaction of polyethylene, polypropylene, polyester and nylon.

TEXT/REFERENCE BOOKS:

1. Morrison R.T. and Boyd R. N., Organic Chemistry, Allyn and Bacon Inc, Boston, 1992
2. Mukherjee S. M., Singh S. P. and Kapoor R. P., Organic Chemistry Vol. I/II, Wiley Eastern Ltd., New Delhi, 1985
3. Solomons G., Fundamentals of Organic Chemistry, John Wiley, 2002
4. Carey F. A., Organic Chemistry, McGraw Hill, Inc, 2003

Note:

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2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

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B. Tech. Semester - III (Chemical Engineering)
LC-CHE-209-G: FLUID FLOW LAB

L	T	P	Credits				
-	-	2	1		**Class Work**	:	**25 Marks**
					Examination	:	**25 Marks**
					Total	:	**50 Marks**
					Duration of Examination	:	**3 Hours**

Course Objectives: Chemical Engineering lab provides students the first hand experience of verifying various theoretical concepts learnt in theory courses. It also servers as a bridge between theory and practice. This particular lab focuses on mass transfer

Course Outcomes: Students will be able to
1: Learn how to experimentally verify various theoretical principles
2: Visualize practical implementation of chemical engineering equipment
3: Develop experimental skills.
4: Learn to use various flow meters

LIST OF PRACTICALS / DEMONSTRATIONS:
1. Flow measurement by Venturimeter.
2. Flow measurement by Orificemeter.
3. Calibration of Rotameter.
4. Flow measurement by V-notch.
5. Pressure drop in pipe flow.
6. Verification of Bernoulli's Theorem.
7. Centrifugal pump test rig.
8. Flow measurement by Pitot tube

NOTE:
1. The students will be required to perform the 06 experiments from above list; remaining two experiments may either be performed from the above list or designed and set by the Dept. as per the scope of the syllabus of CHE207C.
2. The students will be allowed to use non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
3. Electronics gadgets including Cellular phones are not allowed in the examination.

B.Tech. Semester-III/IV (Common for all Branches)

MC201C : ENVIRONMENT SCIENCE

L	T	P	Credits			
3	-	-	-	**Field/Class Work**	**:**	**25 Marks**
				Examination	**:**	**75 Marks**
				Total	**:**	**100 Marks**
				Duration of Examination	**:**	**3 hours**

Course Objectives: To educate and empower the student in assessment of environments and their impacts on our living standards, and methods of correcting the damaged environments.

Course Outcomes:

On completion of the course, the students will be able to:

1. Develop concepts of basic environmental factors.
2. Introduce to the students the basic understanding of ecosystem and its structural and functional aspects and vast biodiversity
3. Outline aspects of environmental issues.
4. Understand the knowledge of energy resources and their environmental implications

Syllabus Contents:

Unit-1 The Multidisciplinary nature of environment studies. Definition, scope and importance. (2 lecture)

Unit-2 Natural Resources :

Renewable and non-renewable resources :

Natural resources and associated problems.

a) Forest resources : Use and over-exploitation : deforestation, case studies. Timber extraction, mining dams and their effects on forests and tribal people.

b) Water resources : Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

c) Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources : World food problems, changes, caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, Water logging, salinity, case studies.

e) Energy resources : Growing energy needs; renewable and non-renewable energy sources, use of alternate energy sources, case studies.

f) Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

* Role of an individual in conservation of natural resources.

* Equitable use of resources for sustainable lifestyles.

(8 lectures)

Unit-3 Ecosystems :

* Producers, consumers and decomposers.
* Energy flow in the ecosystem.
* Ecological succession.
* Food chains, food webs and ecological pyramids.
* Introduction, types, characteristic features, structure and function of the following eco-system :

a. Forest ecosystem.

b. Grassland ecosystem.

c. Desert ecosystem.

d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) (6 lectures)

Unit-4 Biodiversity and its conservation

* Introduction - Definition : Genetic, Species and ecosystem diversity.
* Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.
* Biodiversity at global, National and local levels.
* India as a mega-diversity nation.
* Hot-spots of biodiversity.
* Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.
* Endangered and endemic species of India.
* Conservation of biodiversity : In-situ and ex-situ conservation of biodiversity.

(8 lectures)

Unit-5 Environmental pollution :

Definition, causes, effects and control measures of :

a) Air pollution.

b) Water pollution

c) Soil pollution

d) Marine pollution

e) Noise pollution

f) Thermal pollution

g) Nuclear hazards

* Solids waste management: causes, effects and control measures of urban and industrial wastes.
* Role of an individual in prevention of pollution.
* Pollution case studies.
* Disaster management : floods, earthquake, cyclone and landslides.

(8 lectures)

Unit-6 Social issues and the Environment:

* From unsustainable to sustainable development.
* Urban problems related to energy.
* Water conservation, rain water harvesting, watershed management.
* Resettlement and rehabilitation of people : its problems and concerns case studies.
* Environmental ethics : Issues and possible solutions.
* Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.
* Wasteland reclamation.
* Consumerism and waste products.
* Environment Protection Act.
* Air (Prevention and Control of pollution) Act.
* Water (Prevention and Control of pollution) Act.
* Wildlife Protection Act.
* Forest Conservation Act.
* Issues involved in enforcement of environmental legislation.
* Public awareness. (7 lectures)

Unit-7 Human population and the Environment.

Population growth, variation among nations.

Population explosion- Family Welfare Programme.

Environment and human health.

Human Rights.

Value Education.

HIV/AIDS.

Woman and Child Welfare

Role of Information Technology in Environment and human health.

Case Studies. (6 lectures)

Unit-8 Field Work :

* Visit to a local area to document environmental assets - river/forest/grassland/hill/mountain.
* Visit to a local polluted site-urban/Rural/ Industrial/ Agricultural.
* Study of common plants, insects, birds.
* Study of simple ecosystems- pond, river, hill slopes, etc. (Field work equal to 10 lecture hours).

References

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Pub. Ltd. Bikaner.

2. Bharucha, Frach, The Biodiversity of India, MApin Publishing Pvt. Ltd. Ahmedabad-380013, India, E-mail : mapin@icenet.net(R).
3. Brunner R.C. 1989, Hazardous Waste Incineration, Mc. Graw Hill Inc. 480p.
4. Clark R.S., Marine pollution, Slanderson Press Oxford (TB).
5. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Pub. House, Mumbai 1196 p.
6. De A.K., Environmental Chemistry, WileyEastern Ltd.
7. Down to Earth, Centre for Science and Environment (R).
8. Gleick, H.P., 1993. Water in crisis, Pacific Institute for Studies in Dev. Environment & Security Stockholm Env. Institute, Oxford Univ. Press, 473p.
9. Hawkins R.E. Encyclopedia of Indian Natural History, Bombay Natural HistorySociety, Bombay(R).
10. Heywood, V.H. & Watson, R.T. 1995. Global Biodiversity Assessment, Cambridge Uni. Press 1140p.
11. Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284p.
12. Mackinney, M.L. & Schoch, RM 1996, Environmental Science systems & solutions, Web enhanced edition. 639p.
13. Mhaskar A.K., Mayyer Hazardous, Tekchno-Science Publications (TB).
14. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB).
15. Odum, E.P. 1971, Fundamentals of Ecology. W.B. Saunders Co. USA, 574p.
16. Rao M.N. & Datta, A.K. 1987 Waste Water Treatment. Oxford & TBH Publ. Co. Pvt. Ltd. 345p.
17. Sharma, B.K. 2001, Environmental Chemistry, Goal Publ. House, Meerut.
18. Survey of the Environment, The Hindu (M).
19. Townsend C., Harper J. and Michael Begon. Essentials of Ecology, Blackwell Science (TB).
20. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Comliances and Standards, Vol. I and II Enviro Media (R).

(R) Reference (TB) Textbook

The scheme of the paper will be under :

The subject of Environmental Studies will be included as a qualifying paper in all UG Courses and the students will be required to qualify the same otherwise the final result will not be declared and degree will not be awarded.

B. Tech. Semester - IV (Chemical Engineering)

PCC-CHE-202-G : CHEMICAL ENGINEERING THERMODYNAMICS

L	T	P	Credits				
3	**-**	**-**	**3**		**Class Work**	**:**	**25 Marks**
					Examination	**:**	**75 Marks**
					Total	**:**	**100 Marks**
					Duration of Examination	**:**	**3 Hours**

Course Objectives: To introduce the concepts of fugacity, activity coefficient, vapour-liquid equilibrium and reaction equilibrium. Introduction to molecular thermodynamics.

Course Outcomes:

1. Students will be able to calculate and apply fugacity, activity coefficients, and equilibrium constants to analyze phase equilibria and reaction equilibria problems.

2. Students will demonstrate an understanding of vapor-liquid equilibrium, liquid-liquid equilibrium, vapor-liquid-liquid equilibrium, solid-liquid equilibrium, and solid-vapor equilibrium by solving related problems.

3. Students will be able to use molecular thermodynamics concepts to explain phase equilibrium phenomena and analyze multi-component systems.

4. Students will be proficient in using thermodynamic models and equations of state to predict behavior and solve problems involving phase equilibria, chemical reaction equilibria, and molecular-level interactions.

Syllabus contents:

UNIT-I: Review of first and second law of thermodynamics, Phase Equilibria - Importance of phase equilibria in process industries,phase rule, simple model for vapour – Liquide quilibria (VLE), VLE by modified Raoult's law; VLE from K-value correlations; Flash calculations, VLE calculations at low and high pressures, Activity coefficients from experimental data - Margules, van-laar, Wilson Equations.

UNIT-II: Solution Thermodynamics: fundamental property relationships, free energy and chemical potential, partial properties, definition of fugacity and fugacity coefficient of pure species and species in solution, the ideal solution and excess properties,activity coefficients.

UNIT-III: Liquid phase properties from VLE, Models for excess Gibbs energy, heat effects and property change on mixing, UNIFAC and UNIQUAC models,

UNIT-IV: Chemical Reaction Equilibrium - Reaction coordinate, application of equilibrium criteria to chemical reactions, standard Gibbs free energy change and the equilibrium constant, effect of Temperature on equilibrium constant, evaluation of equilibrium constants and composition, calculation of equilibrium compositions for single reactions, introduction of multi reaction equilibria, .Introduction to molecular/statistical thermodynamics

TEXT BOOKS:

1. J.M. Smith, H.C. Van Ness and M.M. Abbott, Introduction to Chemical Engineering Thermodynamics, 7th edition, McGraw-Hill International Edition,2005. 2. Mass Transfer Operations: R.E. Treybal 3rd edition Mcgraw-Hill Book Company New Delhi..
2. Y.V.C. Rao, Chemical Engineering Thermodynamics: Universities Press (India) Ltd., Hyderabad, India

REFERENCE BOOKS:

1. S.Sandler, "Chemical, Biochemical and Engineering Thermodynamics", 4th edition,Wiley,India.
2. Chemical and Process Thermodynamics: B.G. Kyle - Prentice Hall of India Pvt. Ltd., New Delhi.

Note:

1. In Semester Examinations, the examiner will set two questions from each unit (total 8 questions in all) covering the entire syllabus. The students will be required to attend only five questions selecting atleast one question from each unit.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

For student admitted in B. Tech. 1st Year (C-Scheme) in 2019 and all trailing students.

Examinations and evaluation of students shall be conducted as per guidelines AICTE Examinations Reforms covering the entire syllabus. The students shall be made aware about the reforms.

B. Tech. Semester - IV (Chemical Engineering) **PCC-CHE-204-G : NUMERICAL METHODS IN CHEMICAL ENGINEERING**							
L	**T**	**P**	**Credits**		**Class Work**	**:**	**25 Marks**
3	**1**	**-**	**4**		**Examination**	:	**75 Marks**
					Total	:	**100 Marks**
					Duration of Examination	:	**3 Hours**

Course Objectives: To introduce students to numerical methods used to solve engineering problems, in particular chemical engineering problems, using numerical methods and computer programming. Fundamentals of numerical methods/algorithms to solve systems of different mathematical equations (e.g. linear/ non-linear algebraic equations, ordinary /partial differential equations), will be introduced.

Course Outcomes: Course Outcomes: Students will be able to write their own computer programs using programming languages like C and commercial software like Matlab. Hands-on experience will be provided to apply these computer programs to solve problems in different areas of chemical engineering e.g. fluid flow, heat and mass transfer, chemical reaction engineering etc**.**

1. Students will demonstrate proficiency in using numerical methods and algorithms, including root-finding, optimization, differentiation, integration, and solving systems of equations.

2. Students will implement numerical methods to solve chemical engineering problems using appropriate programming languages and tools.

3. Students will analyze the accuracy, efficiency, and stability of different numerical methods for various chemical engineering applications.

4. Students will apply numerical solution techniques for systems of linear and nonlinear algebraic equations, ordinary differential equations, and partial differential equations relevant to chemical engineering.

Syllabus:

UNIT-I: Introduction, Approximation and Concept of Error & Error Analysis. Linear Algebraic Equations: Methods like Gauss elimination, LU decomposition and matrix inversion, Gauss-Siedel method, Chemical engineering problems involving solution of linear algebraic equations. Root finding methods for solution on non-linear algebraic equations: Bisection, Newton-Raphson and Secant methods, Chemical engineering problems involving solution of non-linear equations

UNIT-II: Interpolation and Approximation, Newton's polynomials and Lagrange polynomials, spline interpolation, linear regression, polynomial regression, least square regression. Numerical integration: Trapezoidal rule, Simpson’s rule, integration with unequal segments, quadrature methods, Chemical engineering problems involving numerical differentiation and integration

UNIT-III: Ordinary Differential Equations: Euler method, Runge-Kutta method, Adaptive Runge-Kutta method, Initial and boundary value problems, Chemical engineering problems involving single, and a system of ODEs.

UNIT-IV: Introduction to Partial Differential Equations: Characterization of PDEs, Laplace equation, Heat conduction /diffusion equations, explicit, implicit, Crank-Nicholson method.

TEXT BOOKS:

1. Gupta, S. K., "Numerical Methods for Engineers, New Academic Science, 2012

REFERENCE BOOKS:

1. S.C. Chapra& R.P. Canale, "Numerical Methods for Engineers with Personal Computer

Applications", McGraw Hill Book Company, 1985.

2. R.L. Burden & J. D. Faires, "Numerical Analysis", 7th Ed., Brooks Coles, 2000.

3. Atkinson, K. E., "An Introduction to Numerical Analysis", John Wiley & Sons, 1978.

4. Press, W. H. et al., "Numerical Recipes in C: The Art of Scientific Computing, 3rd Edition, Cambridge University Press, 2007.

Note:

1. In Semester Examinations, the examiner will set two questions from each unit (total 8 questions in all) covering the entire syllabus. The students will be required to attend only five questions selecting atleast one question from each unit.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

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B. Tech. Semester - IV (Chemical Engineering)

PCC-CHE-206-G : PARTICLE & FLUID PARTICLE PROCESSING

L	T	P	Credits		Class Work	:	25 Marks
3	-	-	3		Examination	:	75 Marks
					Total	:	100 Marks
					Duration of Examination	:	3 Hours

Course Objectives: Objectiveof this course is to introduce students to the numerous industrial operations dealing with the particulate solids, their handling in various unit operations, and those in which particle-fluid interactions are important. The course addresses fundamentals of fluid-particle mechanics, such as the notion of drag, and builds on those fundamentals to develop design concepts for various industrial processes like packed bed operation, fluidized operations, sedimentation, filtration, separation of solids and fluids, etc. Industrial applications are discussed. The course is concluded with an introduction to colloidal systems, soft materials and nanoparticles. Applications of these novel systems are discussed.

Course Outcomes:

Students will be able to

1. Calculate drag force and terminal settling velocity for single particles
2. Calculate pressure drop in fixed and fluidised beds
3. Analyze filtration data and select systems based on requirements, estimate filtration area for given requirements, understand filter aids and their usage
4. Describe Size reduction energy requirements, estimate performance of equipment, selection and sizing of equipment

Syllabus contents:

UNIT-I: Introduction: Relevance of fluid and particle mechanics, and mechanical operations, in chemical engineering processes Solid particle characterization: Particle size, shape and their distribution; Relationship among shape factors and particle dimensions; Specific surface area; Measurement of surface area. Flow around immersed bodies: Concept of drag, boundary layer separation, skin and form drag, drag correlations.

UNIT-II: Packed bed: Void fraction, superficial velocity, channeling, Ergun equation and its derivation, Kozeny Carman equation, Darcy's law and permeability, Blaine's apparatus. Fluidization: Fluidized bed, minimum fluidization velocity, pressure drop, Geldart plot etc. Types of fluidization: Particulate fluidization, Bubbling fluidization, Classical models of fluidization, Circulating fluidized beds, Applications of fluidization.

UNIT-III: Separation of solids from fluids: Introduction. Sedimentation: Free Settling, hindered settling, Richardson-Zaki equation, design of settling tanks. Filtration: Concepts, design of bag filters, design of electrostatic filters. Centrifugal separation, design of cyclones and hydrocyclones

UNIT-IV: Size reduction, milling, laws of communition, classification of particles Size enlargement; Nucleation and growth of particles, Transport of fluid-solid systems: pneumatic and hydraulic conveying, Colloidal particles: stabilization, flocculation, Introduction to nanoparticles: Properties, characterization, synthesis methods, applications

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TEXT BOOKS:

1. McCabe, W., Smith, J. and Harriott, P. Unit Operations of Chemical Engineering, 6th edition., McGraw Hill.

2. 2. Coulson and Richardson's Chemical Engineering, Vol. 2, Butterworth-Heinemann, Fifth edition 2002.

REFERENCE BOOKS:

1. Rhodes, M. J., Introduction to Particle Technology, 2nd edition, John Wiley, Chichester ; New York, 2008.
2. Allen, T., Powder Sampling and Particle Size Determination, Elsevier, 2003.
3. Masuda, H., Higashitani, K., Yoshida, H., Powder Technology Handbook, CRC, Taylor and Francis, 2006.
4. Vollath, D. Nanomaterials: An Introduction to Synthesis, Properties and Applications, 2nd Ed., Wiley, 2013.

Note:

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	B. Tech. Semester - IV (Chemical Engineering) PCC-CHE-208-G : HEAT TRANSFER						
L	**T**	**P**	**Credits**		**Class Work**	**:**	**25 Marks**
3	**1**	**-**	**4**		**Examination**	:	**75 Marks**
					Total	:	**100 Marks**
					Duration of Examination	:	**3 Hours**

Course Objectives:

- Basic Concepts of Heat Transfer
- Design and Rating of Heat exchangers with and Without Phase Change
- Design and Rating of Compact Heat Exchangers

Course Outcomes:

Students will be able to

1. Identify and select type of shell and tube exchanger based on TEMA classification
2. Design double pipe heat exchanger,
3. Design Shell and tube heat exchanger,
4. Design finned tube and other compact heat exchangers

Syllabus contents:

UNIT-I: Heat Transfer Fundamentals: Modes of heat transfer, thermal diffusivity and heat transfer coefficient, Differential equations of heat transfer, special forms.

Conductive heat transfer - one dimensional problem, heat transfer from extended surfaces, two and three dimensional problems, Insulation. Unsteady state heat transfer

UNIT-II: Convective heat transfer - natural and forced convection; Dimensional analysis; Thermal boundary layer; Analogies and Correlations.

UNIT-III: Design of heat transfer equipment - double pipe heat exchanger, concept of LMTD, DPHE sizing; Shell and tube heat exchanger - Kern's method for design, effectiveness-NTU method, construction, aspects in brief, Bell Delaware Method.Design aspects of finned tube and other compact heat exchangers

UNIT-IV: Introduction to Radiative Heat Transfer; Basics of Heat transfer with phase change - Introduction to boiling, Introduction to condensation, Design aspects of Condensers, Reboilers and Evaporators. Heat Transfer to Agitated tanks, Design aspects of Furnaces

TEXT BOOKS:

1. R. Welty, C. E. Wicks, R. E. Wilson, G. Rorrer, Fundamentals of Momentum, Heat and Mass Transfer, 4th Ed.,Wiley (2007).

2. W. J. McCabe, J. Smith, P. Harriot, Unit Operations of Chemical Engineering, Sixth Edition, McGraw Hill (2005).

3. Holman, J. P., S. Bhattacharya, Heat Transfer, 10th Ed., Tata McGraw-Hill (2011).

4. D. Q. Kern, Process Heat Transfer, Tata-McGraw Hill (1997).

REFERENCE BOOKS:

1. Bejan, A., A. D. Kraus, Heat Transfer Handbook, John Wiley (2003).

Note:

1. In Semester Examinations, the examiner will set two questions from each unit (total 8 questions in all) covering the entire syllabus. The students will be required to attend only five questions selecting atleast one question from each unit.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

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B.Tech. Semester-IV (Chemical Engineering)

HSMC-201-G : ENGINEERING ECONOMICS (common with CE)

L	T	P	Credits			
3	-	-	3	**Class Work**	:	**25 Marks**
				Examination	:	**75 Marks**
				Total	:	**100 Marks**
				Duration of Examination	:	**3 hours**

Course Objectives:

Course Outcomes:

Syllabus Contents:

UNIT – I: Concept of Economics- various definitions, nature of Economic problem, Micro and macro economics- their features and scope, production possibility curve, Relationship between Science, Engineering Technology and Economics. Utility: Concept and measurement of utility, Law of Diminishing Marginal Utility, Law of equi-marginal utility – its importance and practical applications.

UNIT – II: Demand: Concept, Individual and Market demand schedule, Law of demand, shape of demand curve. Elasticity of demand: Concept, measurement of elasticity of demand, factors affecting elasticity of demand, practical application of elasticity of demand. Various concepts of cost- Fixed cost, variable cost, average cost, marginal cost, money cost, real cost, opportunity cost.

UNIT – III: Meaning of production and factors of production; Law of variable proportions, Law of Return to Scale, Internet and External economics and diseconomies of scale. Meaning of Market, Type of Marker– perfect Competition, Monopoly, Oligopoly, Monopolistic competition (Main features of these markers).

UNIT – IV: Supply and Law of Supply, Role of Demand & Supply in Price Determination and effect of changes in demand and supply on price. Nature and characteristics of Indian economy, privatization – meaning, merits and demerits.Globalisation – meaning, merits and demerits.

TEXT BOOKS:

1. Ahuja H.L"MicroEcomomic Theory" S. Chand Publication, New Delhi
2. Dewett K.K "Modern Ecomomic Theory" S. Chand Publication, New Delhi
3. Jain T.R, Grover M.L, Ohri V.K Khanna O.P,"Economics for engineers" V.K .Publication ,New Delhi
4. Dr. R.K. Agarwal & Rashmi Agarwal, " Principles and Applications of Economic", PragatiPrakashan.

REFERENCE BOOKS:

1. Jhingan 1. JhinganM.L"MicroEcomomic Theory" S.Chand Publication ,New Delhi
2. Chopra P.N "Principle of Economics" Kalyani Publishers, Delhi
3. Mishra S.K "Modern Micro Economics" Pragati Publication Mumbai. 44
4. DwivediD.N "Micro Economics " Pearson Education, New Delhi.

Note:

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2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

For student admitted in B. Tech. 1st Year (C-Scheme) in 2019 and all trailing students.

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B.Tech. Semester-III (Chemical Engineering)

BSC-BIO-205-G : BIOLOGY

L	T	P	Credits			
3	-	-	3	**Class Work**	:	**25 Marks**
				Examination	:	**75 Marks**
				Total	:	**100 Marks**
				Duration of Examination	:	**3 hours**

Course Objectives:

- To learn about the significance of biology as an important scientific discipline for engineers.
- To get a basic knowledge of classification and organization of living organisms.
- To learn about the various biomolecules, and to understand their role in biological metabolism.
- To understand the fundamentals of nature & structure of genetic material, and the flow of genetic information in biological systems.

Course Outcomes:

1. Students will become familiar with the hierarchy of life forms at phenomenological level**.**
2. Students will understand the molecular basis of information transfer in the biological systems.
3. Students will learn about the significance of different building blocks of life forms, and the fundamental principles of energy transactions in the biological world.
4. The students will get an overview of the importance of studying biological systems for resolving the existing global issues with an engineering perspective.

Syllabus Contents:

UNIT-I:

Introduction: Significance of biology; Why study biology;Biological observations in history that led to the discovery of some major engineering basics (brownian motion & origin of thermodynamics); **F**undamental similarities and differences between science and engineering-humans as the best machines, comparison between eye and camera, flying of a bird and aircraft etc.

Classification: Classification based on (a) Cellularity- unicellular or multicellular (b) Ultrastructure- prokaryotes or eukaryotes (c) Energy and carbon utilization- autotrophs, heterotrophs and lithotrophs (d) Ammonia excretion- aminotelic, uricotelic, or ureotelic (e) Habitat- aquatic or terrestrial; Molecular taxonomy- three major kingdoms of life.

Single-celled organisms – Microorganisms and Microbiology: Concept of- single-celled organisms**,** species & strains; Identification and classification of microorganisms; Ecological aspects of single-celled organisms; Microscopy.

UNIT – II:

Biomolecules: Molecules of Life- Monomeric units and polymeric structures- sugars, starch and cellulose; Amino acids and proteins; Nucleotides and DNA/ RNA; Two carbon units and lipids.

Proteins and Enzymes: Proteins- structure and function; Hierarchy in protein structure-primary, secondary, tertiary and quarternary structure; Proteins as enzymes, transporters, receptors and structural elements; Enzymes: classification and mechanism of action; Enzyme catalyzed reactions; Enzyme kinetics and kinetic parameters; RNA catalysis.

UNIT – III: **Genetics:** Genetics is to biology what Newton's laws are to physics; Mendel's laws of genetics; Concept of- allele, recessiveness and dominance, segregation and independent assortment; Genetic material passes from parent to offspring; Epistasis; Mapping of phenotype to genes, gene/ linkage mapping; Single gene disorders in humans; Meiosis and mitosis.

Genes, Chromosomes and Information transfer: DNA as genetic material; Hierarchy of DNA structure- single stranded to double stranded to nucleosomes to chromosomes; Molecular basis of information transfer; Concept of genetic code; Universality and degeneracy of genetic code.

UNIT – IV: **Metabolism:** Similarities between fundamental principles of energy transactions in physical and biological world; Thermodynamics as applied to biological systems; Exothermic and endothermic versus endergonic and exergonic reactions; Concept of K_{eq} and its relation to standard free energy; Spontaneity; ATP as an energy currency; Glycolysis and Krebs cycle (breakdown of glucose to CO_2 to H_2O); Photosynthesis (synthesis of glucose from CO_2 and H_2O); Energy yielding and energy consuming reactions; Concept of energy change

TEXT/REFERENCE BOOKS:

1. Biology: A global approach: Campbell, N.A.; Reece, J.B.; Urry, Lisa; Cain. M.L.; Wasserman, S.A.; Minorsky, P.V.; Jackson, R.B. Pearson Education Ltd.
2. Outlines of Biochemistry, Conn, E.E.; Stumpf, P.K.; Bruening, G.; Doi, R.H.; John Wiley and Sons.
3. Principles of Biochemistry (V Edition), By Nelson, D.L.; and Cox, M.M.W.H. Freeman and Company.
4. Molecular Genetics (Second edition), Stent, G.S.; and Calender, R.W.H. Freeman and Company. Distributed by Satish Kumar Jain for CBS Publisher.
5. Microbiology, Prescott, L.M.J.P.; Harley and C.A. Klein. 1995. 2nd edition W.M.C. Brown Publishers.

Note:

1. In Semester Examinations, the examiner will set two questions from each unit (total 8 questions in all) covering the entire syllabus. The students will be required to attend only five questions selecting atleast one question from each unit.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.

For student admitted in B. Tech. 1st Year (C-Scheme) in 2019 and all trailing students.

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	B. Tech. Semester - IV (Chemical Engineering) **LC-CHE-210-G : NUMERICAL METHODS IN CHEMICAL ENGINEERING LAB**						
L	**T**	**P**	**Credits**		**Class Work**	**:**	**25 Marks**
-	**-**	**2**	**1**		**Examination**	:	**25 Marks**
					Total	:	**50 Marks**
					Duration of Examination	:	**3 Hours**

Course Objectives: To introduce students to numerical methods used to solve engineering problems, in particular chemical engineering problems, using numerical methods and computer programming. Fundamentals of numerical methods/algorithms to solve systems of different mathematical equations (e.g. linear/ non-linear algebraic equations, ordinary /partial differential equations), will be introduced.

Course Outcomes: Students will be able to solve chemical engineering problems involving

1. Linear and non-linear equations,
2. Ordinary and
3. partial differential equations using programming languages like C/C++ and
4. software like MATLAB

LIST OF EXPERIMENTS:

Write down and execute the following programs using C/C++/MATLAB

1. To find the roots of non-linear equation using Bisection method
2. To find roots of non-linear equation using Newton's method
3. Curve fitting by least square approximations
4. To solve system of linear equations using Gauss-Elimination method
5. To solve system of linear equations using Gauss-Seidal iteration method
6. To solve system of linear equations using Gauss-Jordan method
7. To integrate numerically using Trapezoidal rule
8. To integrate numerically using Simpson's rule
9. To find largest Eigen value of a matrix by power-method
10. To find numerical solution of ordinary differential equations by Euler's method
11. To find numerical solution of ordinary differential equations by Runge-Kutta method
12. To find numerical solution of ordinary differential equations by Milne's method
13. To find numerical solution of Laplace equation
14. To find numerical solution of wave equation
15. To find numerical solution of heat equation

BOOKS SUGGESTED:

1. Applied Numerical Analysis by Curtis F. Gerald and Patrick G. Wheatley-Pearson, Edu. Ltd.
2. Numerical Methods: E.Balaguruswamy T.M.H

NOTE:

1. Ten experiments are to be performed out of which at least seven experiments should be performed from the above list. Remaining three experiments should be performed from the above list or designed and set by the department as per the scope of the syllabus of CHE204C.
2. The students will be allowed to use non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
3. Electronics gadgets including Cellular phones are not allowed in the examination

B. Tech. Semester - IV (Chemical Engineering) LC-CHE-212-G: MECHANICAL OPERATIONS LAB							
L	**T**	**P**	**Credits**		**Class Work**	**:**	**25 Marks**
-	**-**	**2**	**1**		**Examination**	**:**	**25 Marks**
					Total	**:**	**50 Marks**
					Duration of Examination	**:**	**3 Hours**

Course Objectives: Chemical Engineering lab provides students the first hand experience of verifying various theoretical concepts learnt in theory courses. It also serves as a bridge between theory and practice. This particular lab focuses on mass transfer

Course Outcomes: Students will be able to

1. Learn how to experimentally verify various theoretical principles
2. Visualize practical implementation of chemical engineering equipment
3. Develop experimental skills
4. Learn size reduction, settling velocity, filtration concepts.

LIST OF PRACTICALS / DEMONSTRATIONS:

1. Settling of single particle.
2. Sedimentation.
3. Size reduction by Jaw Crusher &Pulverizer.
4. Grinding in a Ball Mill.
5. Screen analysis.
6. Separation of dust particles from air.
7. Determination of pressure drop across a fluidized bed and a packed bed.
8. Filtration of slurry

NOTE:

1. The students will be required to perform the 06 experiments from above list; remaining two experiments may either be performed from the above list or designed and set by the Dept. as per the scope of the syllabus of CHE206C.
2. The students will be allowed to use non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
3. Electronics gadgets including Cellular phones are not allowed in the examination.

B. Tech. Semester – IV (Chemical Engineering) LC-CHE-214-G= HEAT TRANSFER LAB							
L	**T**	**P**	**Credits**		**Class Work**	**:**	**25 Marks**
-	**-**	**2**	**1**		**Examination**	**:**	**25 Marks**
					Total	**:**	**50 Marks**
					Duration of Examination	**:**	**3 Hours**

Course Objectives:

Chemical Engineering lab provides students the first hand experience of verifying various theoretical concepts learnt in theory courses. It also servers as a bridge between theory and practice. This particular lab focuses heat transfer

Course Outcomes

Students will be able to

1. Learn how to experimentally verify various theoretical principles
2. Visualize practical implementation of chemical engineering equipment
3. Develop experimental skills in HT equipments
4. Develop quantitative measurement and reasoning skils.

LIST OF EXPERIMENTS / EXERCISES:

1. Determination of overall heat transfer coefficient.
2. Film wise & drop wise condensation.
3. Efficiency of a long tube evaporator.
4. Effectiveness of pin-fin.
5. Determination of LMTD.
6. Natural Convection heat transfer.
7. Forced convection heat transfer.
8. Thermal conductivity of insulating powder.
9. Determination of emissivity.

NOTE:

1. The students will be required to perform the 06 experiments from above list; remaining two experiments may either be performed from the above list or designed and set by the Dept. as per the scope of the syllabus of CHE208C.
2. The students will be allowed to use non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
3. Electronics gadgets including Cellular phones are not allowed in the examination.

B.Tech. Semester-III/IV (Common for all Branches)

MC-317-G : CONSTITUTION OF INDIA

L	T	P	Credits	Class Work	:	GRADE
3	-	-	-	Examination	:	

Course Objectives:

To make students conscious citizens of India and well equip them to explain and understand the importance of constitution of the country.

Course Outcomes:

At the end of the course students will be able to

1. To understand basic features of the constitution and rights and duties of Indian citizens
2. To understand the basic structure of Centre and State Government
3. To get acquainted with the nature of parliamentary form of Government
4. To have knowledge of the executive and judiciary powers in Indian democratic set-up

Syllabus Contents:

CONSTITUTION OF INDIA– BASIC FEATURES AND FUNDAMENTAL PRINCIPLES The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America. The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

COURSE CONTENT 1. Meaning of the constitution law and constitutionalism.

2. Historical perspective of the Constitution of India.

3. Salient features and characteristics of the Constitution of India.

4. Scheme of the fundamental rights.

5. The scheme of the Fundamental Duties and its legal status.

6. The Directive Principles of State Policy – Its importance and implementation.

7. Federal structure and distribution of legislative and financial powers between the Union and the States.

8. Parliamentary Form of Government in India – The constitution powers and status of the President of India

9. Amendment of the Constitutional Powers and Procedure

10. The historical perspectives of the constitutional amendments in India

11. Emergency Provisions : National Emergency, President Rule, Financial Emergency

12. Local Self Government – Constitutional Scheme in India

13. Scheme of the Fundamental Right to Equality

14. Scheme of the Fundamental Right to certain Freedom under Article 19

15. Scope of the Right to Life and Personal Liberty under Article 21

REFERENCES:

1. The Constitutional Law Of India 9 th Edition, by Pandey. J. N.

2. The Constitution of India by P.M.Bakshi

3. Constitution Law of India by Narender Kumar

4. Bare Act by P. M. Bakshi