

For Batches 2018 & Onwards  
Academic Autonomous Status vide letter No.

**Shaheed Bhagat Singh State Technical Campus, Ferozepur Punjab**  
**Department of Chemical Engineering**  
**B.Tech. Chemical Engineering**  
**Scheme of Syllabi (2018 Onwards)**  
**3<sup>rd</sup> Semester (Second Year) -Curriculum**

**Total Contact Hours= 25**

Sr. No.	Course Code	Course Title	Hours per week			Marks Distribution		Total Marks	Credit
			L	T	P	Internal	External		
1.	BTCH-301B	Engineering & Solid Mechanics (SOM)	3	1	0	40	60	100	4
2.	BTCH-302B	Thermodynamics-I	3	1	0	40	60	100	4
3.	BTCH-303B	Transport Phenomena	3	1	0	40	60	100	4
4.	BTCH-304B	Material & Energy Balance Computations	3	1	0	40	60	100	4
5.	BTCH-305B	Fluid Mechanics	3	1	0	40	60	100	4
6.	BTCH-306B	Environmental Sciences (Mandatory Non-credit course)	2	-	-	-	-	-	0
7.	BTCH-307B	Chemical Engineering Lab-I (FF & SOM lab)	0	0	3	30	20	50	1
<b>Total</b>			<b>17</b>	<b>5</b>	<b>3</b>	<b>230</b>	<b>320</b>	<b>550</b>	<b>21</b>

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**Department of Chemical Engineering**  
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**4<sup>th</sup> Semester (Second Year) -Curriculum**

**Total Contact Hours= 26**

Sr. No.	Course Code	Course Title	Hours per week			Marks Distribution		Total Marks	Credit
			L	T	P	Internal	External		
1.	BTCH-401B	Heat Transfer	3	1	0	40	60	100	4
2.	BTCH-402B	Mass Transfer-I	3	1	0	40	60	100	4
3.	BTCH-403B	Thermodynamics-II	3	1	0	40	60	100	4
4.	BTCH-404B	Materials Science	3	0	0	40	60	100	3
5.	BTCH-405B	Numerical Methods in Chemical Engineering	3	1	0	40	60	100	4
6.	BTHU-401B	HASS-II (Professional skills)	3	0	0	40	60	100	3
7.	BTCH-406B	Numerical Methods in Chemical Engineering Lab	0	0	2	30	20	50	1
8.	BTCH-407B	Chemical Engineering Lab-II (Thermo & HT lab)	0	0	3	30	20	50	1
<b>Total</b>			<b>18</b>	<b>3</b>	<b>5</b>	<b>300</b>	<b>400</b>	<b>700</b>	<b>24</b>

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**5<sup>th</sup> Semester (Third Year) -Curriculum**

**Total Contact Hours= 25**

Sr. No.	Course Code	Course Title	Hours per week			Marks Distribution		Total Marks	Credit
			L	T	P	Internal	External		
1.	BTCH-501B	Chemical Reaction Engineering-I	3	1	0	40	60	100	4
2.	BTCH-502B	Mass Transfer-II	3	1	0	40	60	100	4
3.	BTCH-503B	Particle & Fluid Particle Processing	3	0	0	40	60	100	3
4.	Core Elective-I		3	0	0	40	60	100	3
	BTCH-511B	Optimization Techniques							
	BTCH-512B	Plant Utilities							
	BTCH-513B	Enzyme Tech.							
5.	BTCH-	Open Elective-I	3	0	0	40	60	100	3
6.	BTHU-501B	HASS-III (Project Management)	3	0	0	40	60	100	3
7.	BTCH-504B	Chemical Engineering Lab-III ( MT lab)	0	0	3	30	20	50	1
8.	BTCH-505B	Constitution of India/Essence of Indian Traditional Knowledge	2	-	-	-	-	-	-
<b>Total</b>			<b>20</b>	<b>2</b>	<b>3</b>	<b>270</b>	<b>380</b>	<b>650</b>	<b>21</b>

**Shaheed Bhagat Singh State Technical Campus, Ferozepur Punjab**  
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**6<sup>th</sup> Semester (Third Year) -Curriculum**

**Total Contact Hours= 26**

Sr. No.	Course Code	Course Title	Hours per week			Marks Distribution		Total Marks	Credit
			L	T	P	Internal	External		
1.	BTCH-601B	Chemical Reaction Engineering-II	3	1	0	40	60	100	4
2.	BTCH-602B	Chemical Process Industries	3	0	0	40	60	100	3
3.	BTCH-603B	Energy & Pollution Engg.	3	1	0	40	60	100	4
4.	Core Elective-II		3	0	0	40	60	100	3
	BTCH-611B	Chemical Process Safety							
	BTCH-612B	Corrosion Engg.							
	BTCH-613B	Fluidization Tech.							
5.	BTHU- 601B	HASS-IV (Process Engg. Economics)	3	0	0	40	60	100	3
6.	BTCH-604B	Chemical Engineering Lab –IV (CRE & Enviromental Engg. lab)	0	0	3	30	20	50	1
7.	BTCH-605B	Chemical Equipment Design	1	0	2	30	20	50	2
8.	BTCH-	Open Elective-II	3	0	0	40	60	100	3
<b>Total=</b>			<b>19</b>	<b>2</b>	<b>5</b>	<b>300</b>	<b>400</b>	<b>700</b>	<b>23</b>

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**Scheme of Syllabi (2018 Onwards)**  
**7<sup>th</sup> Semester (Fourth Year) -Curriculum**

**Total Contact Hours= 25**

Sr. No.	Course Code	Course Title	Hours per week			Marks Distribution		Total Marks	Credit
			L	T	P	Internal	External		
1.	Core Elective-III		3	0	0	40	60	100	3
	BTCH-711B	Polymer Science & Reactor Design							
	BTCH-712B	Heat Exchangers							
	BTCH-713B	Separation Processes							
2.	Core Elective - IV		3	0	0	40	60	100	3
	BTCH-714B	Petroleum Engg. & Tech							
	BTCH-715B	Biochemical Engg.							
	BTCH-716B	Fuel Cell Technology							
3.	BTCH-701B	Process Instrumentation dynamics & Control	3	1	0	40	60	100	4
4.	BTCH-	Open Elective-III	3	0	0	40	60	100	3
5.	BTCH-	Open Elective-IV	3	0	0	40	60	100	3
6.	BTCH-702B	Process Optimization & Simulation Lab	0	0	3	30	20	50	1
7.	BTCH-703B	Instrumentation & Control Lab	0	0	3	30	20	50	1
8.	BTCH-704B	Chemical Process Plant Design	1	0	2	30	20	50	3
<b>Total</b>			<b>16</b>	<b>1</b>	<b>8</b>	<b>290</b>	<b>360</b>	<b>650</b>	<b>21</b>

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**8<sup>th</sup> Semester (Fourth Year) -Curriculum**

**Total Contact Hours= 00**

Sr. No.	Course Code	Course Title	Hours per week			Marks Distribution		Total Marks	Credit
			L	T	P	Internal	External		
	BTCH-801B	Summer Industry internship Project				200	200	400	12
<b>Total=</b>			<b>0</b>	<b>0</b>	<b>0</b>	<b>200</b>	<b>200</b>	<b>400</b>	<b>12</b>

**3<sup>rd</sup> Semester**  
**BTCH-301B Engineering and Solid Mechanics**

**External Marks: 60**

**L T P**

**Internal Marks: 40**

**3 1 0**

**Total Marks: 100**

**Objectives:** Students would be introduced to fundamentals of Engineering Mechanics with emphasis on force systems. 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.

**Rigid body kinematics:**

**(4 hrs)**

Translation and rotation, relative motion, angular velocity, Laws of motion, (Euler's Axioms), General motion of a rigid body, General relative motion.

**Simple Stresses & Strains:**

**(6 hrs)**

Simple stresses and strains : Concept of stress and strain; St. Vernants principle, stress and strain diagram, Hooke's law, Young's modulus, Poisson ratio, stress at a point, stress and strains in bars subjected to axial loading. Modulus of elasticity, stress produced in compound bars subject to axial loading .Temperature, stress and strain calculations due to applications of axial loads and variation of temperature in single and compound bars.

**Slopes and Deflections of Beams:**

**(6 hrs)**

Slopes and deflections in beams and cantilevers, calculation of slopes and deflections using double integration moment area theorems and Macullay's method. Shear Force and Bending Moment diagram.

**Theory of Bending:**

**(6 hrs)**

Compound stress and strains, the two dimensional system; stress at a point on a plane, principal stresses and principal planes; Mohr's circle of stress; ellipse of stress and their applications. Generalized Hook's Law, principal stresses related to principal strains

**Analysis of Structures:**

**(4 hrs)**

Trusses, Equivalent force systems, Resultant forces, Linear and Angular Momentum, Free Body Diagrams, Equilibrium of rigid bodies, distributed forces.

**Theories of failure:**

**(6 hrs)**

Strain energy, various theories of failure, their necessity and significance, graphical representation of theories of failure.

**Torsion of shafts and springs:**

**(6 hrs)**

Torque, angle of twist and shear stresses in hollow and solid shafts with in elastic limit, assumptions intrusion, power transmitted by a shafts, analysis of close coil spring subjected to axial load couple. Shafts subjected to torsion.

**Thin Cylinders/ spheres:**

**(4 hrs)**

Thin cylinders subjected to internal pressure, circumferential and longitudinal stress and strains, maximum shear stress, increase in diameter and volume, thin spheres subjected to internal pressure.

**Columns:**

**(6 hrs)**

Columns under uniaxial loads, buckling of columns slenderness ratio, and conditions. Derivations of Euler's formula for elastic-buckling load, equivalent length, Rankine-Garden empirical formula.

**BOOKS RECOMMENDED:**

1. Timoshenko, S., Young D.H. , Sukumar P., Rao J. V. Engineering Materials 5<sup>th</sup> Edition, McGraw Hill Education.
2. Timoshenko, S., Strength of Materials Vol-I: Elementary Theory and Problems, 3<sup>rd</sup> Edition, CBS Publishers, 2002
3. Vazirani V.N. & Ratwani, Analysis of Structures, Vol. I, 17<sup>th</sup> Ed., Khanna Publishers
4. Bansal, R.K., Strength of Materials, 4<sup>th</sup> Ed., Luxmi Publishers, 2010.
5. Popov E. P., Engineering Mechanics of Solids, 2nd Ed., Prentice Hall, 1999

**Course outcomes**

Students will be able to:

1. Understand the basic concepts of rigid body kinematics.
2. Understand the concept of stress and strain at a point and stress analysis in various machine elements like thin cylinder, sphere, spring, beams and shafts.
3. Tackle the problems related to shearing Force, bending moment, slope and deflections in different types of beams subjected to various types of loadings.
4. Apply the knowledge of various theories of failures to design the various structural components subjected to different types of loadings.
5. Understand the concept of buckling of slender, long columns subjected to axial loads and be able to solve problems related to columns and struts.

## BTCH-302B Thermodynamics-I

**External Marks: 60**

**Internal Marks: 40**

**Total Marks: 100**

**L T P**

**3 1 0**

**Objectives:** This course covers the application of thermodynamic principles to chemical engineering problems. It involves principles and application of first, second and third laws of thermodynamics.

**Introduction (4 hrs)**

Scope of thermodynamics, Dimensions and Units, Temperature, Pressure, Work, Energy and Heat.

**Energy conservation & first law of thermodynamics: (6 hrs)**

State functions; Equilibrium; Phase Rule; Reversible process; Constant P, V, T processes; Mass and energy balances for open systems.

**Phases: (8 hrs)**

Phase transitions, PVT behaviour; description of materials – Ideal gas law, Vander Waals, virial and cubic equations of state; Reduced conditions & corresponding states theories; correlations in description of material properties and behaviour.

**Heat effects: (4 hrs)**

Latent heat, sensible heat, Standard heat of formation, reaction and combustion, flame temperature, Enthalpy for phase change etc.

**Second law of thermodynamics: (10 hrs)**

Statement of Second law of thermodynamics, 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. Throttling process, Joule-Thomson coefficient, Third law of thermodynamics and its applications

**Thermodynamic property of fluids: (4 hrs)**

Maxwell relations, 2-phase systems, graphs and tables of thermodynamic properties.

**Thermodynamics of Process: (6 hrs)**

Application of thermodynamics to flow processes-pumps, compressors and turbines, Thermodynamic analysis of Steam power plants and Rankine cycle.

**Carnot refrigerator: (6 hrs)**

Vapor-compression cycle; Absorption refrigeration; Heat pump, Liquefaction processes of gases.

### BOOKS RECOMMENDED:

1. Smith J.M. and Van Ness, H.C, Introduction to Chemical Engineering Thermodynamics, 7<sup>th</sup> Ed., McGraw Hill Book Co., 2005
2. Dodge B.F., Chemical Engg. Thermodynamics, McGraw - Hill Book Company, Inc.
3. Balzhiser R., Samuels M., Eliassen J., Chemical Engineering Thermodynamics, Prentice Hall, 1972.
4. M J Moran, H N Shapiro, D D Boettner and M B Bailey, Principles of Engineering Thermodynamics, 8th Edition, Willey .

### Course outcomes

Students should be able to

1. Apply the concept of Ist, IInd and the IIIrd laws of thermodynamics.
2. Apply mass and energy balances to closed and open systems.
3. Apply the heat effects to various sensible heat and latent heat processes.
4. Evaluate the properties of Gases, concept of non-ideal gases and its governing correlations.
5. Solve problems involving liquefaction, refrigeration and different power cycles.

For Batches 2018 & Onwards  
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**BTCH-303B Transport Phenomena**

**External Marks: 60**

**Internal Marks: 40**

**Total Marks:100**

**L T P**

**3 1 0**

**Objective:** This course introduces the student to the rigorous formulation of transport problems using the conservation principles and flux expressions, and identifies the similarities and differences among the transport processes for momentum, heat and mass. The main focus of the course is on microscopic treatment of transport problems, with particular emphasis on proper use of dimensional analysis and scaling arguments.

**Review:** Basic concepts of vector & tensor analysis and introduction to transport phenomena. Formulation of transport problems from nature, concept of boundary layer, laminar and turbulent flows. **(8 hrs)**

**Basics of Transport phenomena:** Basics of mass, energy and momentum transport. Newton's law of viscosity, Fourier's Law of heat conduction and Fick's law of diffusion. **(10 hrs)**

**Shell balances :**

Shell energy balance and shell mass balance for solving specific problems of transport of momentum, heat and mass in laminar flow or in solids in one dimension. **(10 hrs)**

**One dimensional transport problems:**

Development of general differential equations, one-dimensional steady state and unsteady state problems of momentum, heat and mass transfer. **(8 hrs)**

**Interphase transport:**

Interphase transport of Momentum, heat and mass and dimensionless correlations for each one of them. **(6 hrs)**

**Transport Analysis:**

Emphasis on analogies between momentum, heat and mass transfer with respect to transport mechanism and governing equations. **(6 hrs)**

**BOOKS RECOMMENDED:**

1. Bird R.B., Stewart, W.E. and Lightfoot, E.N., Transport Phenomena, 2<sup>nd</sup> Ed., John Wiley & Sons, 2005.
2. Geankoplis C.J., Transport Processes and Separation Process Principles (Includes Unit Operations), 4th Ed., Prentice Hall, 2003
3. Weaty, J.R. Wilson, R.E. and Wicks, C.E., Fundamentals of Momentum Heat and Mass Transfer, 4<sup>th</sup>Ed., John Wiley & Sons.
4. Bennett.C.O. and Myres J.E., Momentum Heat and Mass Transfer, 3<sup>rd</sup> Ed., McGraw Hill, 1982.

**COURSE OUTCOMES**

The students are able to:

1. Demonstrate the knowledge momentum, heat, mass transport and vector & tensor analysis.
2. Simplify the momentum transport problems using shell balances.
3. Apply the conservation principles for the microscopic analysis of the given situation and solve the same for heat transport.
4. Apply the conservation principles for the microscopic analysis of the given mass transport situation and solve the same.
5. Analyse the given situation on macroscopic scale for transport of momentum, heat and mass and their analogies.

## BTCH-304B Material & Energy Balance Computations

External Marks: 60

L T P

Internal Marks: 40

3 1 0

Total Marks: 100

**Objective:** The objective of this course is to present to the students, an introduction to chemical engineering calculations, establish mathematical methodologies for the computation of material balances, energy balances and to present an overview of industrial chemical processes. It is prerequisite for several other courses in the curriculum, including courses in process dynamics, heat transfer and phase equilibrium.

### 1. Introduction to Chemical Engineering Calculations: (8 hrs)

Units & Dimensions, Conversion of units, Mole concept, Basic Concept, Stoichiometric and composition relationship, limiting-excess- reactant, conversion and yield, “basis” of calculations Degrees of Freedom.

### 2. Material Balance:

*Without Chemical reaction* - Ideal gas-law calculations, real-gas relationships, vapour pressure of immiscible liquids, solutions and problems based on Raoult’s, Henry & Dalton's Law. Absolute Humidity, Relative Humidity, Saturation, Dry bulb temperature, Wet bulb temperature, Adiabatic saturation temperature & use of psychometric Chart.

*With Chemical Reaction*- Combustion, gas-synthesis, acid-alkali production recycle, purge, bypass in batch, stage-wise and continuous operations in systems with or without chemical reaction. (16 hrs)

### 3. Energy Balance:

*Review:* Standard heat of formation and combustion, standard heat of reaction, problems using Hess Law. open and closed system, heat capacity, calculation of enthalpy changes Heat balances for non reacting processes and reaction processes. Theoretical flame temperature, Adiabatic reaction temperature, flame temperature, combustion calculation. (14 hrs)

### 4. Gases, Vapors Liquids and Solids:

Equations of state, Vapor pressure, Clausius-Clapeyron equation, Cox chart, Duhring’s plot, Raoult’s law, Crystallization, Dissolution. (6 hrs)

**5. Humidity:** Saturation, humid heat, humid volume, dew point, humidity chart and its use.

(4 hrs)

### Suggested 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.

### Suggested References Books

1. Felder, R. M.; Rousseau, R. W., “Elementary Principles of Chemical Processes”, Third Edition, John Wiley & Sons, 2000
2. Hougen, O. A., Watson, K. M., Ragatz, R. A., “Chemical Process Principles, Part-I Material & Energy Balances”, Second Edition, CBS Publishers & Distributors, 2004
3. Venkataramani, V., Anantharaman, N., Begum, K. M. Meera Sheriffa, “Process Calculations”, Second Edition, Prentice Hall of India.
4. Sikdar, D. C., “Chemical Process Calculations”, Prentice Hall of India.

### **COURSE OUTCOMES**

Students would be able to:-

1. Demonstrate the knowledge of basic Chemical Engineering Calculations involving units & dimensions, stoichiometry and degree of freedom analysis.
2. Apply material balance on Chemical Engineering processes with & without chemical reaction.
3. Apply thermophysics and thermochemistry-laws for applying energy balance on Chemical Engineering processes.
4. Be familiar with equations of state and properties of gases and liquids, including phase transition, crystallization and dissolution operations.
5. Comprehend the concept of humidity and usage of psychometric charts.

### **BTCH-305B Fluid mechanics**

**Objective:** The course introduces the students to the principles of fluid mechanics that are of fundamental importance to chemical engineers i.e. fluid statics and dynamics, boundary layer, laminar and turbulent flows, fluid machinery etc. It is a prerequisite to Heat Transfer, Mass Transfer I & II

<b>Introduction</b>	<b>(2 hrs)</b>
Concept of fluid, difference between solids, liquids and gases; ideal and real fluids, Introduction to fluid statics and fluid flow	
<b>Fluid Statics</b>	<b>(4hrs)</b>
Normal forces in fluids, Manometers of different types, Forces on submerged bodies, Buoyancy and stability.	
<b>Fluid Properties</b>	<b>(8 hrs)</b>
Concept of capillarity, vapour pressure, compressibility and bulk modulus, Newtonian and non- Newtonian Fluids, Nature of turbulence, Eddy Viscosity, Flow in Boundary Layers.	
<b>Basic Equations of Fluid Flow</b>	<b>(6 hrs)</b>
Momentum Balance, Continuity equation, Bernoulli's Equations, Navier Stokes Equations, Derivation and Application,	
<b>Dimensional Analysis of Fluid Flow:</b>	<b>(4 hrs)</b>
Problems using Rayleigh method and Buckingham $\pi$ method, Dimensionless numbers and their significance	
<b>Flow of Incompressible Fluids</b>	<b>(8 hrs)</b>
Concept of boundary layer, Laminar and Turbulent flow in pipes, Velocity distribution in pipes, Frictional Losses in pipes and fittings, effect of roughness, Fanning Equation, Estimation of Economic Pipe Diameter, Derivation of Hagen Poiseuille's equation and $f = 16/ Re$ .	
<b>Flow of Compressible Fluids</b>	<b>(4 hrs)</b>
Compressible flow, basic equation, Mach number and its significance and isentropic flow through nozzles	
<b>Flow Measurement</b>	<b>(6 hrs)</b>
In closed channels - Pitot tube, Orifice meter, venturimeter, Rotameter In open channels- Notches, Weirs	
<b>Fluid Machinery</b>	<b>(6 hrs)</b>
Classification and performance of Pumps, Positive displacement pumps and its types, Centrifugal pumps- characteristic curves, Net positive Suction Head and cavitation, Turbines, Compressors, Blowers, Selection and specification.	

#### **BOOKS RECOMMENDED:**

1. McCabe, Warren L., Smith, Julian C. and Harriot, P., Unit Operations of Chemical Engg., 7<sup>th</sup> Ed., McGraw Hill, 2005
2. Backhurst J.R., Harker J.H., Coulson J.F., Richardson J.M., Chemical Engineering – Volume 1, 6<sup>th</sup> Ed., Butterworth Heinemann, 1999
3. Foust, A.S., Wenzel L.A., Clump C.W. Maus L., Anderson L. B., Principles of Unit Operations, 2<sup>nd</sup> Ed., John Wiley & Sons, 2008.
4. Raju K.S., Fluid Mechanics, Heat Transfer, and Mass Transfer: Chemical Engineering Practice, John Wiley and Sons, 2011
5. Badger, W.L. and Banchero, J.T, Introduction to Chemical Engg., McGraw Hill.
6. Philip J. Pritchard P. J., Fox and McDonald's Introduction to Fluid Mechanics, 8th Ed., John Wiley and Sons, 2011
7. Chattopadhyay, P., Unit Operations of Chemical Engg. Vol.1, 3rd Ed., Khanna Publishers.

#### **COURSE OUTCOMES**

Students would be able to:-

1. Knowledge of basic principles of fluid mechanics.
2. Ability to analyze fluid flow problems with the application of the momentum and energy equations.
3. Ability to decide when appropriate to use ideal flow concepts, continuity equation and Bernoulli equation.
4. Understanding and analysis of problems using methodical dimensional analysis.
5. Capability to analyze pipe flows as well as fluid machinery.

## **BTCH-306B Environmental Sciences (Mandatory Non-credit course)**

**Objective:** The course provides a basic understanding of concept of multidisciplinary nature of Environmental Science & basic problems of exploitation & environmental effects of using Natural Resources. It provides an ability to identify threats to Bio-diversity, relationship among Social-issues, human population and their potential solutions. An awareness about causes, effects & control measures of various types of environmental Pollution.

### **Part A**

- Introduction:** (2 hrs)  
Definition and scope and importance of multidisciplinary nature of environment. Need for public awareness.
- Natural Resources:** (2 hrs)  
Natural Resources and associated problems, use and over exploitation, case studies of forest resources and water resources.
- Ecosystems:** (2 hrs)  
Concept of Ecosystem, Structure, interrelationship, producers, consumers and decomposers, ecological pyramids-biodiversity and importance. Hot spots of biodiversity.
- Environmental Pollution:** (6 hrs)  
Definition, Causes, effects and control measures of air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste Management: Causes, effects and control measure of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster Management : Floods, earthquake, cyclone and landslides.

### **PART B**

- Social Issues and the Environment:** (8 hrs)  
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.
- Human Population and the Environment:** (4 hrs)  
Population growth, variation among nations. Population explosion - Family Welfare Programme. Environment and human health, Human Rights, Value Education, HIV/AIDS. Women and child Welfare. Role of Information Technology in Environment and human health. Case studies.

For Batches 2018 & Onwards  
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**BTCH-307B Chemical Engineering Lab-I**

**External Marks: 20**  
**Internal Marks: 30**  
**Total Marks: 50**

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**0 0 3**

**LIST OF EXPERIMENTS**

**PART A**

1. Plot the characteristic curves of a centrifugal pump.
2. Verification of Bernoulli's equation for flow process.
3. Measurement of flow by a venturimeter
4. Measurement of flow by an orifice meter.
5. Measurement of flow by a rotameter
6. Measurement of flow by a V-notch in an open channel.
7. Measurement of losses in various fitting and valves.
8. Measurement of losses due to contraction and expansion.
9. Measurement of losses due to variation in cross section/ shapes.
10. Verification of laminar/ turbulent flow regime in a flow process.

**PART B**

1. Determination of yield points, tensile strength and ultimate strength of mild steel specimen.
2. Determination of compressive strength of mild steel specimen.
3. Bending test of mild steel specimen.
4. Tensile test of a specimen of brittle material.
5. Torsion test of a mild steel specimen.
6. Determination of Brinell's hardness of ductile and brittle materials.
7. Determination of Rockwell Hardness of a hard material.
8. Performance of Vickers's Hardness test.
9. Determination of Impact strength of a specimen.

At least five experiments should be conducted from each part.

**COURSE OUTCOMES:**

At the end of the course the student will able to:

1. Demonstrate the working of a centrifugal pump.
2. Demonstrate practical understanding of Bernoulli's equation
3. Determine coefficient of discharge of fluids by Venturimeter, Orifice meter and V-notch etc
4. Demonstrate practical understanding of friction losses due to various fitting and valves, contraction and expansion or due to variation in cross section/ shapes.
5. Demonstrate practical understanding of determination of yield points, tensile strength compressive strength and ultimate strength
6. Present results in form of written reports.