Indrashil University

(Established by an Act under the Gujarat Private Universities Act, 2009)

A Life Sciences University

Sustained Excellence with Relevance

School of Engineering

Chemical and Biochemical Engineering

Proposed Course Curriculum

w.e.f Academic Year 2019-20

B.TECH. (All Branches) ENGINEERINGPROGRAMME (w.e.f. academic year 2019-20)

Semester : 1	**Minimum Semester Credit Required :21 Cumulative Semester Credit Required : 21**		
Course Code	**Subject Name**	**L-T-P**	**Credits**
CHE101	Engineering Chemistry	**3-0-2**	**4**
MATH 101	Engineering Mathematics-I	**3-1-0**	**4**
HS 101	Communication Skills – I	2-2-0	4
TA 101 / TA 102	Computer Programming / Engineering Graphics	**3-0-2/2-0-4**	**4/4**
HS 102	Soft Skills – I	2-0-0	0
ES 101 / ES 102	Engineering Mechanics / Electrical Technology	2-1-2/3-0-2	4/4
WS101	Engineering Workshop	0-0-2	1
	Total	**15-4-8/15-3-10**	**21/21**
Semester : 2	**Minimum Semester Credit Required :22 Cumulative Semester Credit Required : 43**		
Course Code	**Subject Name**	**L-T-P**	**Credits**
PHY 101	Engineering physics	**3-0-2**	**4**
MATH 102	Engineering Mathematics-II	**3-1-0**	**4**
HS 103	Communication Skills – II	2-2-0	4
TA 102 / TA 101	Engineering Graphics / Computer Programming	**2-0-4/3-0-2**	**4/4**
HS 104	Soft Skills – II	2-0-0	0
ES 102 / ES 101	Electrical Technology / Engineering Mechanics	3-0-2/2-1-2	4/4
ES 103	Environmental science	2-0-0	2
	Total	**17-3-8/17-4-6**	**22/22**

CURRICULUM FOR B.TECH. CHEMICAL AND BIOCHEMICAL ENGINEERING PROGRAMME

Semester : 3	**Minimum Semester Credit Required : 22 Cumulative Semester Credit Required : 65**		
Course Code	**Subject Name**	**L-T-P**	**Credits**
MATH301	Engineering Mathematics-III	3-1-0	4
CH301	Heat Transfer Operations	3-0-2	4
CH302	Fluid Flow Operations	3-0-2	4
CY301	Physical and Analytical Chemistry	3-0-2	4
CH303	Process Calculations	3-1-0	4
HS301	SS-III	2-0-0	0
CH304	Engineering Innovation Project-I	0-0-2	1
CH305	Community Connect Programme	0-0-1	1
	Total	**17-2-7**	**22**
Semester : 4	**Minimum Semester Credit Required : 20 Cumulative Semester Credit Required : 85**		
Course Code	**Subject Name**	**L-T-P**	**Credits**
CH401	Material Science	3-0-0	3
CH402	Chemical Engineering Thermodynamics	3-1-0	4
CH403	Mass Transfer Operations-I	3-0-2	4
CH404	Mechanical Operations and Particulate Technology	3-0-2	4
CY401	Inorganic and Organic Chemistry	3-0-2	4
HS401	SS-IV	2-0-0	0
CH405	Engineering Innovation Project-II	0-0-2	1
	Total	**17-1-8**	**20**

Semester : 5	Minimum Semester Credit Required : 23 Cumulative Semester Credit Required : 108		
Course Code	**Subject Name**	**L-T-P**	**Credits**
CH501	Mass Transfer Operations-II	3-0-2	4
CH502	Chemical and Fuel Process Technology	3-0-2	4
CH503	Chemical Reaction Engineering-I	3-0-2	4
CH5E1	Elective-I	3-0-0	3
CH5E2	Elective-II	3-0-0	3
HS501	SS-V	2-0-0	0
CH504	Engineering Innovation Project -III	0-0-2	1
CH505	Industrial Practices*	0-0-0	4
	Total	**17-0-8**	**23**
Semester : 6	**Minimum Semester Credit Required : 22 Cumulative Semester Credit Required : 130**		
Course Code	**Subject Name**	**L-T-P**	**Credits**
CH601	Chemical Reaction Engineering-II	3-0-2	4
CH602	Process Equipment Design	3-0-2	4
CH603	Instrumentation and Process Control	3-0-2	4
CH6E1	Elective-III	3-0-0	3
CH6E2	Elective-IV	3-0-0	3
CH6E3	Elective-V	3-0-0	3
HS601	SS-VI	2-0-0	0
CH604	Engineering Innovation Project -IV	0-0-2	1
	Total	**20-0-8**	**22**

Semester : 7	Minimum Semester Credit Required : 22 Cumulative Semester Credit Required : 152		
Course Code	**Subject Name**	**L-T-P**	**Credits**
CH701	Biochemical Engineering	3-0-0	3
CH702	Chemical Engineering Economics and Plant Design	3-1-0	4
CH7E1	Elective- VI	3-0-0	3
HS701	Foreign Language	3-0-0	3
IU7E1	Elective-VII	3-0-0	3
HS702	SS-VII	2-0-0	0
CH703	Engineering Innovation Project -V	0-0-2	1
CH704	Industrial Practices*	0-0-0	4
CH705	Comprehensive Viva	0-0-0	1
	Total	**17-1-2**	**22**
Semester : 8	**Minimum Semester Credit Required : 15 Cumulative Semester Credit Required : 167**		
Course Code	**Subject Name**	**L-T-P**	**Credits**
CH801	Project + 2 courses / Thesis / Industry Project /Internship	0-0-30	15
	Total	**0-0-30**	**15**

***Industry Practice of 6 to 8 weeks will be conducted during summer vacations only.**

Specializations:

Bio Process Engineering

Microbiology

Enzyme Engineering and Technology

Bioprocess Engineering

Metabolic Engineering

Sector Technology

Dyes and Dye Intermediates Technology

Pharmaceutical Technology

Petroleum Refining and Petrochemicals

Polymer Technology

Fertilizer Technology

Food Technology

Non-Conventional Energy Sources

Micro and Nano Fluidics

Nanoscience and Nanotechnology
Colloids and Interfacial Science
Microfluidics
Soft nano technology

Environmental Science and Sustainability

Environmental Biotechnology
Air Pollution Control Engineering
Wastewater Engineering
Solid Waste Treatment
Process Safety Engineering
Cleaner Production and Cleaner Technology

Advanced Chemical Engineering

Applied Chemical Process Thermodynamics
Catalytic Reaction Engineering
Advanced Chemical Instrumentation Techniques
Transport Phenomena
Unit Processes
Advanced Separation Techniques
Advances in Chemical Process Control

Process Modelling and Optimization

Chemical Process Optimization
Process Intensification
Process Integration
Process Modelling
Process Simulation Techniques

Soft Social Skill Courses:

1. English
2. Communication Skill
3. Ethics and Values
4. Economics for Engineers
5. Laws for Engineers
6. Entrepreneurship Development
7. Organizational Behaviour

Date:

Indrashil University

School of Engineering

Third Semester, 2019-20

Course Syllabus

Course Code:	**CH 301**
Course Title:	**Heat Transfer Operations**
Credit Structure (L-T-P-C):	**3-0-2-4**
Instructor in Charge:	

Learning Outcome of the Course:

After successful completion of the course, student will be able to:

- explain the characteristics of different modes of heat transfer
- understand mechanism/ phenomenon of evaporation and working of different types of evaporators
- select the suitable heat exchanger and its trouble shooting
- appreciate the advancements in the area of heat transfer operations

Syllabus:

Unit-1 **01 Hour**

Introduction: Applications of heat transfer, Modes of heat transfer: conduction, convection and radiation.

Unit-2 **11 Hours**

Conduction: Fourier's law of conduction, thermal conductivity, Composite solids, Insulation on pipes and concept of optimum insulation thickness, Finned surfaces, Internal heat generation, Transient conduction using lumped capacitance and distributed models, Use of Heisler chart.

Unit-3 **11 Hours**

Convection: Classification of convective heat transfer, Newton's law of cooling, Thermal boundary layer for external forced convection and its solution using boundary integral method, Derivation of Nusselt number correlation for flat plate, constant wall temperature, laminar flow, Empirical correlations for external forced convection, Internal forced convection, Mixing cup temperature, Correlations for internal forced convection, Free convection and related correlations, Boiling, condensation and related correlations.

Unit-4 **06 Hours**

Radiation: Laws of black body radiation and emissivity, Stefan-Boltzmann law, View factor,

Exchange of radiation between surfaces.

Unit-5 **04 Hours**

Heat transfer with phase change: Boiling of liquids, mechanism of boiling, nucleate boiling, and film boiling, Condensation of vapors, Film wise and drop wise condensation.

Unit-6 **06 Hours**

Evaporation: Introduction, performance of an evaporator, individual and overall heat transfer coefficients, capacity and economy of evaporators, Single & multiple effect evaporators, Concept of boiling point elevation, Duhring's rule, and effect of liquid head & friction on pressure drop, Types and application of evaporators.

Unit-7 **05 Hours**

Heat Exchanger: Concept of overall heat transfer coefficient. Types of heat exchangers, LMTD correction factor.

Heat Transfer Operations Lab:

10-12 experiments based on the syllabus covered as above will be performed and evaluated on continuous basis.

Text books

- Rajendra Prakash and Prof. C P Gupta , Process Heat Transfer, Nem Chand & Brithers.
- S. P. Sukhatme, A text-book on Heat Transfer, University Press

Reference Books:

- Frank P. Incropera et al. Fundamentals of Heat and Mass Transfer, Wiley.
- J. P. Holman, Heat Transfer, McGraw Hill.
- Lienhard and Lienhard, A Heat Transfer Text Book, Phlogiston Press
- D. Q. Kern, Process Heat Transfer, McGraw Hill.
- W. McCabe and J. Smith, Unit Operations of Chemical Engineering, McGraw Hill

Open Source Contents:

- NPTEL web or video Course Web-link : http://nptel.ac.in/courses/103103032/ and http://nptel.ac.in/courses/112101097/#
- MIT open courseware : https://ocw.mit.edu/courses/mechanical-engineering/2-051-introduction-to-heat-transfer-fall-2015/index.htm
- MOOC or Moodle courses
- Any other resources: http://www-nix.ecs.umass.edu/~rlaurenc/Courses/che333/notes.html

Evaluation Scheme:

Continuous evaluation process comprising of components like attendance, assignment, class tests, practical, comprehensive examinations, etc.

Date:

Indrashil University

School of Engineering

Third Semester, 2019-20

Course Syllabus

Course Code:	**CH302**
Course Title:	**Fluid Flow Operation**
Credit Structure (L-T-P-C):	**3-0-2-4**
Instructor in Charge:	

Learning Outcome of the Course:

After successful completion of the course, student will be able to

- understand the various physical properties and flow regimes of fluids
- understand and apply the basic equations to solve related problems
- evaluate the operations involving flow through pipes
- select and evaluate the performance of various fluid transport and metering devices

Syllabus:

Unit 1 **04 Hours**

Units and Dimensions - Dimensional analysis, Units and dimensions of various terms involved in fluid flow operations, Basic concepts.

Unit 2 **03 Hours**

Fluid Properties and Fluid Statics: Concept of fluid and flow, Ideal and real fluids, Properties of fluids, Pressure concept, Pascal's law, Hydrostatic equation.

Unit 3 **04 Hours**

Fluid Flow Phenomena: Rheology of fluids, Viscosity, Reynolds no., Laminar flow, Turbulence, Boundary layer.

Unit 4 **06 Hours**

Basic Fluid Flow Equations: Mass balance, Momentum Balance, Mechanical Energy Equation, Correction factors.

Unit 5 **06 Hours**

Agitation and Mixing of Fluids: Standard Agitated Vessel, Power Consumption.

Unit 6 **09 Hours**

Transportation and Metering of Fluids: Pipe and Joints, Pumps– Positive Displacement Pumps, Centrifugal Pumps, Characteristics, Applications, Efficiency, Cavitation and NPSH, Vacuum pumps, Fans, Blowers and Compressors; Valves–Types and Applications, Measurement of Flowing Fluids-Types of Flowmeters, Principle, Application, Notches and Weirs.

Unit 7 **06 Hours**

Incompressible fluid in Pipes: Shear stress and friction in pipes, Laminar flow in pipes, Turbulant flow in pipes, Effect of roughness, Friction factor chart, Hagen-Poiseuille Law, Hydraulic gradient, Series and parallel connection of pipes, Problems.

Unit 8 **03 Hours**

Introduction to Compressible Fluids: Introduction, Basic concepts, Types, Problems

Unit 9 **04 Hours**

Introduction to Multiphase Flow: Introduction, Basic concepts, Types, Problems

Fluid Flow Operations Lab:

10-12 experiments based on the syllabus covered as above will be performed and evaluated on continuous basis.

Text books

- W.L. McCabe, and J. C. Smith, Unit Operations of Chemical Engineering, Mc-Graw Hill Publication.

Reference Books:

- J.M. Coulson and J.F. Richardson, Coulson and Richardson's Chemical Engineering, Vol-I, Pergamon Press.
- Frank Kreith, Fluid Mechanics, CRC Press.
- James O. Wilkes, Fluid Mechanics for Chemical Engineers, Prentice Hall Publication.
- Mathieu Mory, Fluid Mechanics for Chemical Engineers, Wiley Publication.

Evaluation Scheme:

Continuous evaluation process comprising of components like attendance, assignment, class tests, practical, comprehensive examinations, etc.

Date:

Indrashil University
School of Engineering
Third Semester, 2019-20
Course Syllabus

Course Code :	**CH 303**
Course Title :	**Process Calculations**
Credit Structure (L-T-P-C):	**3-1-0-4**
Instructor in Charge:	

Learning Outcome of the Course:

After learning the course the students should be able to

- decide the basic differences between Unit Process and Unit Operations, Units and Dimensions, etc.
- carry out material and energy balance for a given reaction and process.
- explain the importance of dry bulb and wet bulb temperature and its effect on environment and process.
- able to solve the problems of material and energy balance in industry.

Syllabus:

Unit- 1 **10 Hours**

General Concepts: Basic concepts Related to Process, Unit Operation and Unit Process, Units and Dimensions, Conversion of Units, Physical Properties, Ideal and Real Gases, Equation of State, Compressibility and Compressibility Charts, Gas Mixtures.

Unit- 2 **10 Hours**

Material Balance: Basic concepts of Material Balance, Stoichiometry, Material balance with and without chemical reactions, Recycle, bypass, purgecalculations, Material Balance of Multi Unit System, Vapor-liquid equilibrium: Bubble point, dew point calculations, phase envelope, Multi Phase Equilibrium: Phase Diagram and Phase rule

Unit- 3 **10 Hours**

Energy Balance: Introduction to Fuels (solid, liquid and gas): Important properties and specifications. Basic concepts of Energy Balance, Energy Balance without Reaction, Energy Balance for a continuous process, Energy Balance with Chemical Reaction, Standard Heat of Formation, Heat of Reaction, Energy balances with and without chemical reactions; adiabatic flame temperature, Calculations involving multiple units, Heat of Solution and Mixing.

Unit- 4 **10 Hours**

Industrial case studies of complete plant for all type of balances

Tutorials:

8 to 10 tutorials will be given based on the syllabus covered as above.

Text Book

- B. I. Bhatt and S. B. Thakor, Stoichiometry, McGraw Hill Publications

References

- David M. Himmelblau and James B, Riggs, Basic Principles and Calculations in Chemical Engineering, Eighth Edition (2015), Pearson.

Open Source Contents (Provide if available)

- NPTEL web or video Course Web-link
- MIT open courseware
- MOOC or Moodle courses
- Any other resources

Evaluation Scheme:

- Continuous evaluation process comprising of components like attendance, assignment, class tests, comprehensive examinations, etc.

Date:

Indrashil University

School of Engineering

Chemical and Biochemical Engineering

Third Semester, 2019-20

Course Syllabus

Course Code:	**MATH 301**
Course Title:	**Engineering Mathematics - III**
Credit Structure (L-T-P-C):	**3-1-0-4**
Instructor in Charge:	

Learning Course Outcome:

After learning the course the students should be able to:

- apply the basic methods to solve problems in ordinary differential equations;
- classify the partial differential equations and will be able to apply appropriate method to solve the equation;
- represent a function in the form of a Fourier series;
- apply Laplace and Fourier transform technique to solve ordinary and partial differential equation;
- explain the analyticity of a complex function;
- explain conformal mapping and different transformations in complex plane;
- evaluate complex integrations and analyze the singularities of a complex function;
- deal comfortably when encountering and solving the types of problems listed above.
- apply the techniques learnt in this subject to the solution of a comprehensive design problem.

Syllabus:

Unit-I **08 Hours**

Laplace Transform:

Definition of Laplace Transform, Basic properties of Laplace transform, Laplace Transform of derivatives and integrals, Convolution theorem, Inversion, Periodic functions, Solution of initial valued problems.

Unit-II **06 Hours**

Fourier Series:

Periodic functions, Fourier series representation of a function, half range series, sine and cosine series, Fourier integral formula, Parseval's identity.

Unit-III **16 Hours**

Differential equations: Autonomous differential equations, slope fields, phase lines, equilibrium solutions, stable and unstable equilibria, classification of singularities of an ODE, Power series solution for ODE, Bessel functions and Legendre polynomials;Formation of PDEs, Solution of first order Partial Differential equations, Lagrange's Method of solution and its geometrical interpretation, Nonlinear PDEs of first order, Charpit's method, Second order partial differential equations with constant and variable coefficients, classification and reduction of second order equation to canonical form, Method of separation of variables to solve heat equation, D'Alembert's solution of the wave equation.

Unit-IV **15 Hours**

Complex Analysis:

Definition of Analytic Function, Cauchy Riemann equations, Properties of analytic functions, Determination of harmonic conjugate, Milne-Thomson method, Conformal mappings: $\frac{1}{z}$, az, $az+b$, $z+\frac{1}{z}, z^2$ and bilinear transformation,Schwarz-Christoffel transformation, Line & Contour integration, Cauchy's integral theorem (without proof), Cauchy's integral formulae and its applications, Taylor's and Laurent's expansions (statements only), Singularities, Poles and Residues, Cauchy's residue theorem

Tutorials

10-12 tutorials will be given to students based on the syllabus covered as above.

Text Books/References

1. Kreyszig, E., Advanced Engineering Mathematics, John Wiley & Sons
2. Jain, R.K. and Iyengar, S.R.K., Advanced Engineering Mathematics, Narosa Publishers
3. Boyce, W.E. and DiPrima, R.C., Elementary Differential Equations, 7th Ed., John Wiely& Sons
4. Varma and Morbidelli, Mathematical methods in chemical engineering , Oxford University Press
5. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers
6. Churchill, R. V. and Brown, J. W., Complex variables and application, McGraw-Hill

Open Source Contents (Provide if available)

1. https://nptel.ac.in/courses/111106111/
2. https://nptel.ac.in/syllabus/111103021/

Evaluation Scheme:

Continuous evaluation process comprising of components like attendance, tutorials, class tests, comprehensive examinations, etc.

Date:

Indrashil University

School of Engineering

Third Semester, 2019-20

Course Syllabus

Course Code:	**CY 301**
Course Title:	**Physical and Analytical Chemistry**
Credit Structure (L-T-P-C):	**3-0-2-4**
Instructor in Charge:	

Learning Outcome of the Course:

After successful completion of the course, student will be able to

- explain physical properties of compounds and physical methods to determine those properties and their kinetics and catalysis of the reactions
- explain fundamental of analytical techniques like, spectroscopy such as UV-Vis, NMR, fluorescence and fundamentals of photochemistry
- apply appropriate techniques in context to different industries
- implement the knowledge of Chromatography and its different types such as: Column chromatography, HPLC, GC, TLC, HPTLC, GPC

Syllabus:

Unit 1 **03 Hours**

Measurement of pH: Introduction, Determination of pH, P^{Ka}, P^{Kb}, KSP. Application of KSp. ion selective electrode for pH, Instrumentation, Application of pH measurement.

Unit 2 **05 Hours**

Experimental Techniques in Reaction Kinetics: The determination of rate laws from measurement of physical properties, Flow method's for studying reaction kinetics in open systems, rapid reaction methods.

Unit 3 **06 Hours**

Physical Properties and Chemical Constitution: Classification of physical properties, Surface tension and chemical constitutions, Parachor in elucidating structure, Viscosity and chemical constitution, Dipole moments, Molar refraction and constitution, Misceller Properties.

Unit 4 **06 Hours**

Catalyst: Classification of catalysis, Characteristics of Catalyst, Theories of catalysis, Acid base catalysis, Enzyme Catalysis, Surface Catalysis, Homogenous and Heterogeneous catalysis, Catalysis in industry, Catalyst poisoning, Problems associated with catalysis, petrochemical industry.

Unit 5 **05 Hours**

Photochemistry: Photo chemical reactions, Introduction to Jablonskii diagram, photochemical cell, Laws of photochemistry, Quantum yield, photosensitized reactions, Photo physical processes.

Unit 6 **06 Hours**

Ultraviolet spectroscopy: Introduction to EMR,Absortion laws, Origin and theory of Ultraviolet spectra, Types of transition of Organic and Inorganic molecules, Chromophore, Auxochrome, Bathochromic shift, Hypsochromic shift, Woodward-Fischer rules for calculating $\lambda_{max}$of dienes, enones and Aromatic compounds with 5 examples, Major instrumental problems.

Unit 7 **07 Hours**

Introduction to Chromatography: Definition of Chromatrography, Rf Calculation,Types of Chromatography, Principle and applications of TLC, High performance thin layer chromatography (HPLC), Gel permeation chromatography (GPC), Gas Chromatography etc., Major instrumentation problems.

Unit 8 **04 Hours**

Introduction to ^{1}H-Nuclear Magnetic Resonance (NMR): Definition of NMR spectroscopy, Principle, Instrumentation and Applications, Major engineering problems with NMR.

Physical and Analytical Chemistry Lab:

10-12 experiments based on the syllabus covered as above will be performed and evaluated on continuous basis.

Text books/Reference Books:

3. B. S. Bahl, G. D. Tuli, Arun Bahl, Essential of Physical Chemistry, S. Chand Publisher.
4. Chatwal, Anand, Instrumental Methods of Chemical Analysis, Himalaya Publishing House.
5. Peter Atkins, Julio de Paula, The Elements of Physical Chemistry, Oxford University Press.

References:

1. B.D.Khosla, Senior Practical Physical Chemistry, R. Chand & Co.
2. A.I. Vogel: Textbook of Practical Organic Chemistry, 5th edition, Prentice Hall.

Evaluation Scheme:

Continuous evaluation process comprising of components like attendance, assignment, class tests, practical, comprehensive examinations, etc.

Date:

Indrashil University
School of Engineering
Third Semester, 2019-20

Course Syllabus

Course Code :	**HS 301**
Course Title :	**Ethics and Values**
Credit Structure (L-T-P-C):	**2-0-0-0**
Instructor in Charge:	

Scope and Objective:

At the end of the course, students will be able to:

- Develop a familiarity with the mechanics of values and ethics.
- Exercise values, ethics in context of engineering profession, social and personal spectrum
- Apply values and ethics in personal, social, academic, global and professional life.

Learning Outcome of the Course:

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

- Correlate the concepts and mechanics of values and ethics in their life.
- Apply value and ethical inputs to solve social, global and civic issues.
- Apply such principles with reference to cultural values

Syllabus:

Unit-1 **06 Hours**

Introduction to Values: Definition and Concept, Types of Values, Values and its Application.

Unit-2 **06 Hours**

Elements and Principles of Values: Universal & Personal Values**,** Social, Civic & Democratic Values**,** Adaptation Models & Methods of Values.

Unit-3 **06 Hours**

Values and Contemporary Society: Levels of Value Crisis**,** Value Crisis Management, Cultural Values.

Unit-4 **05 Hours**

Ethics and Ethical Values: Definition and Concept**,** Acceptance and Application of Ethics**,** Ethical Issues and Dilemma**,** Universal Code of Ethics: Consequences of Violation

Unit-5 **07 Hours**

Applied Ethics: Professional Ethics**,** Organizational Ethics, Ethical Leadership**,** Ethics influenced by culture

Text books:

Values and Ethics in Business and Profession by Samita Manna, Suparna Chakraborti PHI Learning Pvt. Ltd., New Delhi.

Just a Job?: Communication, Ethics, and Professional life George Cheney Oxford University Press.

Professional Ethics and Human Values M. Govindarajan, S. Natarajan,V. S. Senthilkumar PHI Learning Pvt. Ltd.

Creating Values In Life: Personal, Moral, Spiritual,

Family and Social Values by Ashok Gulla Author House, Bloomington.

Reference Books:

E-Books:

- Ethics for Everyone, Arthur Dorbin, 2009. (http://arthurdobrin.files.wordpress.com/2008/08/ethics-for-everyone.pdf)
- Values and Ethics for 21st Century, BBVA. (https://www.bbvaopenmind.com/wp-content/uploads/2013/10/Values-and-Ethics-for-the-21st-Century_BBVA.pdf)

Evaluation Scheme:

Continuous evaluation process comprising of components like attendance, assignment, class tests, presentations, case studies, etc.

Since it is non-credit course, the students should be qualified/ non-Qualified depending upon their marks and grades obtained.

INDRASHIL UNIVERSITY

Course Name: Engineering Innovation Project

Course Code: CH304 **Course Credit: 01**

Instructor-in-charge: **L-T-P: 0-0-2**

Course Description:

The program requires each student to undertake a project with interdisciplinary group-size up to a maximum of 4 students. Each project group is supervised by up to a minimum of two faculty staffs. In Engineering Innovation Project (EIP), students will take CDIO initiative for their innovation. CDIO (Conceive-Design-Implement-Operate) is an innovative framework in the field of engineering that equips engineers with the knowledge in the state-of-the-art of technology. Conceive, design, implement and operate are the different components of research methodology for which the students have to perform during the incoming semesters III, IV, V and VI respectively. Total credit of this course is four with one credit in each semester. Followings are the steps that the groups of interdisciplinary students are required to follow to secure 4 credits.

1. **Conceive:** This is one of the basic components of CDIO initiative for project work. In this component, students have to conceive the idea of project through observations and literature reviews to define the problems to be solved. Conceive part of project work will be of one credit along with the duration of one semester (semester III).
2. **Design:** Whatever be the problems that were conceived in semester III will be continued to semester IV for designing/simulating/modeling of the defined objectives. This part of the project will also be of one credit for the duration of semester IV.
3. **Implement:** The implementation part will be done in V semester of the same credit 1. In this component, installation and testing will be required to be done for the designed project. The problems related to modeling and simulation can be implemented using different software.
4. **Operate:** In this component, output of solution of the well defined problems will be investigated or analyzed. Results so obtained after operating the installed system will be manipulated and validated with the previous research. This component has to be finished during semester VI and will be of 1 credit.

Course Objectives:

The Objectives of the course are:

- To introduce students to engineering projects.
- To provide students an opportunity to exercise their creative and innovative qualities in a group project environment.
- To excite the imagination of aspiring engineers, innovators and technopreneurs.
- To make students understand why innovation is integral to commercial success.
- To evaluated Innovation strategies and tactics through perspective ideation.

Course Outcomes:

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

- Demonstrate a sound technical knowledge of their selected project topic.
- Undertake problem identification, formulation and solution.
- Design engineering solutions to complex problems utilizing a systems approach.
- Conduct an engineering project
- Communicate with engineers and the community at large in written an oral forms.
- Demonstrate the knowledge, skills and attitudes of a professional engineer.

Evaluation Scheme:

The assessment of Engineering Innovation Project consists of assessment by supervisor in the following areas:

- Technical Knowledge and Skills
- Project Report
- Oral Presentation
- Attendance and Participation
- Interview
- Demonstration

1. **Conceive**

S. No.	Evaluation Component	Weightage	Date and Time
1	Synopsis of work plan	10%	One months after the commencement of semester III
2	Progress report/presentation-1	20%	Two months after the commencement of semester III
3	Progress report/presentation-2	20%	Three months after the commencement of semester III

4	Final Presentation/Viva	50%	End of semester III
Total		**100%**	

2. **Design**

S. No.	Evaluation Component	Weightage	Date and Time
1	Synopsis of design/drawing	10%	One months after the commencement of semester IV
2	Progress report/presentation-1	20%	Two months after the commencement of semester IV
3	Progress report/presentation-2	20%	Three months after the commencement of semester IV
4	Final Presentation/Viva	50%	End of semester IV
Total		**100%**	

3. **Implement**

S. No.	Evaluation Component	Weightage	Date and Time
1	Synopsis of installation	10%	One months after the commencement of semester V
2	Progress report/presentation-1	20%	Two months after the commencement of semester V
3	Progress report/presentation-2	20%	Three months after the commencement of semester V
4	Final Presentation/Viva	50%	End of semester V
Total		**100%**	

4. **Operate**

S. No.	Evaluation Component	Weightage	Date and Time
1	Synopsis of result extraction	10%	One months after the commencement of semester V
2	Progress report/presentation-1	20%	Two months after the commencement of semester V
3	Progress report/presentation-2	20%	Three months after the commencement of semester V
4	Final Presentation/Viva	50%	End of semester V
Total		**100%**	

Reference Book: NA

Date:

Indrashil University
School of Engineering
Fourth Semester, 2019-20

Course Syllabus

Course Code :	**CH 401**
Course Title :	**Material Science**
Credit Structure (L-T-P-C):	**3-0-0-3**
Instructor in Charge:	

Learning Outcome of the Course:

After learning the course the students should be able to

- explain about the fundamental information of chemical engineering materials.
- find structure and characteristics of different materials.
- interpret the phase diagram of metals.
- Find reasons of deterioration of metals.

Syllabus:

Unit-1 **09 hours**

Introduction and history of engineering materials, Engineering Materials, Materials property chart, Crystal structure: Unit cell, metallic crystal structure, crystal systems, Crystallographic direction and planes, Miller indices, Imperfections in solids: point defects, impurities, miscellaneous imperfections, Mechanism of strengthening in metals, Hall-Petch effect, X-ray diffraction, determination of crystal structure.

Unit-2 **09 hours**

Fracture: Ductile, brittle, fatigue. Griffith criterion, S-N curve,

Creep: Power law creep, Norton's law, Mechanisms of creep deformation

Phase diagram (binary): Concept, Solubility Limit, Microstructure, Iron-carbon system, Heat treatment of metals.

Unit-4 **06 hours**

Properties of materials

Electrical properties: Electrical conductivity, electronic and ionic conduction, dielectric strength, piezoelectricity

Thermal Properties: Heat capacity, thermal expansion, thermal conductivity, thermal stress

Magnetic Properties: Diamagnetism, paramagnetism, ferromagnetism

Optical properties: Refraction, reflection, adsorption, transmission, colour

Corrosion, oxidation, thermal stability, wear, abrasion, friction of materials.

Unit-5 **07 hours**

Phase transition of materials: thermogravimetric analysis and differential thermal analyzer

Nanomaterials and their important properties at nanoscale

Characterization Techniques: Optical microscopy, scanning electron microscopy, transmission electron microscopy, atomic force microscopy

Polymer and its characterization: Molecular weight, viscosity, various modes of stress relaxation

Viscoelasticity: Dynamic mechanical analysis (storage and module, complex modulus, damping)

Unit-6 **08 hours**

Composites: Classifications and processing of polymer matrix, ceramic matrix, metal matrix

Characterization of composites: volume fraction of fibers, fracture strength, mechanical properties

Ionic polymer matrix composites, Shape memory alloy

Intelligent multifunctional materials

Introduction to Advanced Materials and its applications in Chemical and Allied Industries

Economics, environment and sustainability

Text books

- V. Raghavan, Material Science and Engineering, Prentice Hall

Reference Books:

- William D. Callister, Material Science and Engineering: An Introduction, John Wiley and Sons
- Michael F. Ashby, Engineering Materials 1: An Introduction to Properties, Application and Design, Elsevier

Open Source Contents:

- NPTEL online course on Material Science and Engineering

Evaluation Scheme:

- Continuous evaluation process comprising of components like attendance, assignment, class tests, comprehensive examinations, etc.

Date:

Indrashil University
School of Engineering
Fourth Semester, 2019-20

Course Handout

Course Code:	**CH 402**
Course Title:	**Chemical Engineering Thermodynamics**
Credit Structure (L-T-P-C):	**3-1-0-4**
Instructor in Charge:	

Learning Outcome of the Course:

After successful completion of the course, student will be able to

- apply basic principles of thermodynamics in engineering
- develop mathematical models for the calculation of heat and work association for any process changes
- calculate properties of pure compounds using different models of equations of state and other mathematical models
- understand the interaction of heat during the process (chemical or physical) and able to apply appropriate model to calculate the energy requirement of any process
- apply knowledge of various flow processes in process industries

Syllabus:

Unit-1 **10 Hours**

Introduction: Basic Concepts and definitions –System, surroundings, Property, Thermodynamic Equilibrium, Equation of state, Gibbs Phase Rule, Reversible and irreversible processes, Path functions and state functions, Concept of energy, heat and work, Phase diagram(s) for pure substances, P-v, T-v, P-T diagrams, Concept of quality, constant quality lines, critical point, triple point, Mathematical Equations of state – Virial and Cubic Equations, Law of corresponding states, Compressibility factor chart (2 and 3 parameter model), Estimation of Measurable Properties (P,v,T), First Law -Joule's Experiment and first law for cyclic process in a closed system, First law for an isolated system, First law for a closed system undergoing a change of state under different conditions – Concept of enthalpy and specific heat capacity

Unit-2 **11 Hours**

Laws of Thermodynamics: First law for a closed system undergoing a change of state under different conditions, First Law for open systems – General case and steady state conditions, Control mass and control volume approach, Charging and discharging of tanks, Throttling process, Reacting systems, Heat of reaction and adiabatic flame temperature,

Second Law: Limitations of first law, Heat Engine and Heat pump, Concept of efficiency and COP, Kelvin Planck and Clausius statements and their equivalence, Carnot cycle and Carnot theorem, Absolute Temperature Scale, Clausius Inequality for Carnot cycle and any cycle -Reversible and Irreversible

Unit-3 **12 Hours**

Second Law (Contd..): Concept of entropy and entropy calculations for different processes in closed systems, Principle of entropy increase in isolated system, Second law for open systems Isentropic Efficiency, Concept of Available Energy, availability and Irreversibility

Third law of thermodynamics:

Combined first and second law and definition of Helmholtz and Gibbs free energy, Maxwell's Equation Tds Equations, Thermodynamic relations from Maxwell's equations, Property estimation for Real gases, Concept of residual property/ departure function, Concept of chemical potential for single component and multicomponent system, Gibbs-Duhem equation

Unit-4 **12 Hours**

Single component two phase system, Clausius Clapeyron and Antoine Equation, Fugacity- concept and definition, Importance of standard states, Fugacity coefficient from P-v-T behaviour of gases, compressibility factors, enthalpy/entropy departure functions, Fugacity of condensed phase, Thermodynamic equilibrium in terms of intensive properties, Gibbs phase rule – proof, Mixtures, Mixing and combining rules for homogeneous mixtures Concept of Partial molar, properties, fugacity estimation, Ideal solutions – Properties, Rauolt's law, Non Ideal solutions- Activity coefficient and its estimation, Chemical Reaction Equilibrium, Equilibrium constant from standard Gibbs free energy, Homogeneous gas phase and liquid phase reactions

Tutorials

10-12 tutorials will be given to students based on the syllabus covered as above.

Text books

- Introduction to Chemical Engineering Thermodynamics, J.M.Smith, H.C.Van Ness, M.M.Abbott, McGraw Hill

Reference Books:

- Chemical Engineering Thermodynamics, Y.V.C.Rao, Universities Press
- Molecular Thermodynamics of Fluid Phase Equilibria, J.M.Prausnitz, R.N.Liehtejthaler and E.G.de Azevedo, Prentice Hall
- Chemical and Process Thermodynamics, B.G.Kyle, Prentice Hall
- Molecular Thermodynamics, D.A.McQuarrie, J.D.Simon, University Science Books
- Engineering Thermodynamics, P.K.Nag, Tata Mc Graw Hill

Open Source Contents:

- NPTEL web or video Course Web-link–Chemical Engineering Thermodynamics by Gargi Das, IIT Kharagpur
- Chemical Engineering Thermodynamics – M.S.Ananth, IIT Madras
  http://nptel.ac.in/syllabus/103106070/
  http://nptel.ac.in/courses/103106070/

  MIT open courseware -
  https://www.youtube.com/watch?v=https://ocw.mit.edu/courses/chemical-engineering/ 10-40-chemical-engineering-thermodynamics-fall-

2003/index.htm?utm_source
=OCWDept&utm_medium=CarouselSm&utm_campaign=FfeaturedCourse

- MOOC or Moodle courses -Course Name: Phase Equilibrium Thermodynamics - Gargi Das
  LINK: https://onlinecourses.nptel.ac.in/noc17_ch10/preview

Evaluation Scheme:

Continuous evaluation process comprising of components like attendance, tutorials, class tests, comprehensive examinations, etc.

Date:

Indrashil University

School of Engineering

Fourth Semester, 2019-20

Course Syllabus

Course Code:	**CH 403**
Course Title:	**Mass Transfer Operations-I**
Credit Structure (L-T-P-C):	**3-0-2-4**
Instructor in Charge:	

Learning Outcome of the Course:

After successful completion of the course, student will be able to

- apply the fundamentals of mass transfer operations and various methods of conducting mass transfer operations in practice.

- estimate the diffusivity for the molecular diffusion in gases and liquids
- understand the concept of local and overall mass transfer coefficients for interphase mass transfer
- evaluate the performance of various mass transfer operations like diffusion, gas absorption, extraction and leaching

Syllabus:

Unit-1 **09 Hours**

Introduction and Classification of Mass Transfer Operations: Molecular Diffusion in Fluids: Molecular diffusion, steady state molecular diffusion in fluids at rest and in laminar flow, molecular diffusion and diffusivity of gases and liquids, concept of Mass transfer coefficient, relation between mass transfer coefficients, film theory, penetration theory, surface renewal theory, combined film-surface renewal theory surface stretch theory, analogies in transfer process.

Unit-2 **09 Hours**

Interphase Mass Transfer: Equilibrium, diffusion between phases, local two phase mass transfer, local overall mass transfer coefficient, material balances for co-current and countercurrent processes, concept of stages.

Unit-3 **07 Hours**

Equipment for Gas-Liquid Operations: Tray towers, packed towers, comparison between tray towers and packed towers.

Unit-4 **05 Hours**

Gas Absorption: Equilibrium solubility of gases in liquids, ideal and non-ideal solutions, choice of solvent for absorption, material balance for co-current and countercurrent flow, minimum liquid gas ratio for absorption and stripping, absorption factor, concept of HETP and HTU, NTU, absorption with chemical reaction.

Unit-5 **08 Hours**

Liquid-Liquid Extraction: Scope, liquid equilibrium, choice of solvent, stage wise contact, single-stage extraction, multi-stage crosscurrent and countercurrent extraction, insoluble liquids, continuous counter current extraction with reflux, performance of different types of extractors used in industries.

Unit-6 **07 Hours**

Leaching: Equilibrium diagrams, single-stage leaching, multistage cross and counter current leaching, equipment for leaching.

Mass Transfer Operations-I Lab:

10-12 experiments based on the syllabus covered as above will be performed and evaluated on continuous basis.

Text books

- Robert E. Treybal, Mass Transfer Operations, McGraw-Hill International Editions.

Reference Books:

- J. F. Richardson, J. H. Harker and J. R. Backhurst, Coulson and Richardson's Chemical Engineering Vol-1, Fluid flow, Heat Transfer and Mass Transfer, Butterworth-Heinemann Publication.
- K. A. Gavhane, Mass Transfer-I, Nirali Prakashan.
- Kiran D. Patil, Principles of Mass Transfer Operations, NiraliPrakashan
- B. K. Dutta, Principles of Mass Transfer and Separation Processes, PHI Learning Pvt. Limited

Evaluation Scheme:

Continuous evaluation process comprising of components like attendance, assignment, class tests, tutorials, practical, comprehensive examinations, etc.

Date:

Indrashil University

School of Engineering

Fourth Semester, 2019-20

Course Syllabus

Course Code:	**CH 404**
Course Title:	**Mechanical Operations And Particulate Technology**
Credit Structure (L-T-P-C):	**3-0-2-4**
Instructor in Charge:	

Course Learning Outcome:

After successful completion of the course, student will be able to

- carryout the particle size distribution of particulate solids
- understand the principles of size reduction and various equipments used for size reduction
- appreciate the applications of various mechanical separations like filtration, sedimentation, centrifugal separations
- understand the significance of mixing of solids and how to evaluate the mixer performance
- have deep insight into other separation methods like froth floatation, jigging, tabling, electrostatic separation.

Syllabus:

Unit-1 **05 Hours**

Particle size analysis-Single particle characterization, Bulk solids, Size distribution equations, Conversion between distributions, Determination of mean particle size Methods of particle size measurement, Industrial screening, Effectiveness of screens.

Unit-2 **05 Hours**

Particle size reduction - Particle fracture mechanisms, Energy requirement for size reduction, Types and characteristics of comminution equipment, Selection of appropriate machine.

Particle size enlargement- Inter particle forces, Comparison and interaction between forces, Granulation rate processes, Granulation equipment

Unit-3 **12 Hours**

Fluid-particle mechanics –Motion of a single solid particle in a fluid – Effect of particle shape - Effect of boundaries, Settling of a suspension of particles –Batch settling, Continuous settling, Motion of particles in a centrifugal field.

Sedimentation and floatation -Fine particles, Coarse particles, Industrial classifiers, Clarifiers and thickeners, Gravity separators ,Flotation equipment.

Centrifugal separations –Gas cyclone and hydro cyclone, Centrifuge, Efficiency of separation, Sedimentation in a centrifugal field.

Unit-4 **02 Hours**

Fluid flow through granular and packed beds of particles, Laminar flow Turbulent flow, Non-spherical particles.

Unit-5 **02 Hours**

Fluidization-Characteristics of fluidized systems, Liquid-solid systems, Gas-solid systems, Applications of the fluidized solids technique.

Unit-6 **04 Hours**

Filtration-Principles of flow through filter cakes and medium, Washing and drying of cake, Filtration practice, Selection of filtration equipment, Filtration in a centrifuge.

Unit-7 **06 Hours**

Hydraulic transport-Flow regimes, Rheological models for homogeneous slurries, Heterogeneous slurries, Components of a transport system.

Pneumatic Transport-Flow regimes, Dilute phase transport, Dense phase transport.

Storage and conveying-Outline of hopper design, Principles of flow of un-aerated powders, Conveying equipment

Unit-8 **02 Hours**

Mixing and segregation –The degree and rate of mixing, Equipment for particulate mixing, Quality and sampling of mixture, Causes and consequences of segregation

Unit-9 **02 Hours**

Hazards of fine powders -Health, fire and explosion hazards, Concept of dust cloud explosions, Control of the hazard.

Mechanical Operations and Particulate technology Lab:
10-12 experiments based on the syllabus covered as above will be performed and evaluated on continuous basis.

Text Books

- W.L. McCabe, and J. C. Smith, Unit Operations of Chemical Engineering, Mc-Graw Hill Publication.
- C. M. Narayan and B. C. Bhattacharya, Mechanical Operations for Chemical Engineers, Khanna Publishers

References

- Martin Rhodes; Introduction to Particle Technology, 2nd Edition; John Wiley & Sons Ltd.
- Coulson, J. M. and Richardson, J. F.; Chemical Engineering, Volume 2: Particle Technology and Separation Processes, 5th Edition, Butterworth-Heinemann.
- Badger, W. L.and Banchero, J. T., Introduction to Chemical Engineering, Tata McGraw-Hill.
- Foust, A. S., Wenzel, L. A., Clump, C. W., Maus, L., Andersen, L. B., Principles of Unit Operations, 2nd Edition; Wiley.
- Coulson, J. M. and Richardson, J. F.; Chemical Engineering, Volume 3: Fluid Flow, Heat Transfer and Mass Transfer, 6th Edition, Butterworth-Heinemann.

Evaluation Scheme:

Continuous evaluation process comprising of components like attendance, assignment, class tests, practical, comprehensive examinations, etc.

Date:

Indrashil University
School of Engineering
Fourth Semester, 2019-20

Course Syllabus

Course Code:	**CY 401**
Course Title:	**Inorganic and Organic Chemistry**
Credit Structure (L-T-P-C):	**3-0-2-4**
Instructor in Charge:	

Learning Outcome of the Course:

After successful completion of the course, student will be able to

- apply the fundamentals and derive the mechanism for the reaction types like substitution, addition, elimination, condensation, hydrolysis, oxidation and reduction
- explain the impact of organic chemistry in the fields of chemical industries, pharmaceutical industries, and its impact on the global economy
- comprehend and analyse organic molecule by performing different test and also acquire the knowledge of material safety data for the same
- explain the synthesis, properties and applications of organic compounds

Syllabus:

Unit-1 **07 Hours**

s,p Group elements: General introduction, electronic configuration, variation of properties, Oxidation states, trends in chemical reactivity, Boron and its compounds reactivity, Catenation of Carbon, N, Si, P, O elements and its related compounds reactivity, Transition metals, Lanthanides, Actinides. (Basic reactivity only)

Unit-2 **08 Hours**

d-block and Co-ordination Chemistry: d-block elements, properties and electronic configuration, oxidation states, Magnetic properties. Valence bond theory, Crystal field theory and Molecular orbital theory.

Unit-3 **03 Hours**

Carboxylic acid: Mechanism of esterification and hydrolysis, tautomerism, preparation of ethyl acetoacetic ester and importance in organic synthesis.

Unit-4 **09 Hours**

Chemistry of organic compounds: Synthesis, properties and industrial uses of chloroform, carbon tetrachloride, ethyl alcohol, methyl alcohol, acetone, acetic anhydride, formaldehyde, acetic acid.

Chemistry of selected organic compounds: Aromatic nitro compound (Nitro benzene), Amino compound (Aniline), hydroxyl compound (Phenol), sulphonium compound (Benzene sulphonic acid), carboxylic acid (Benzoic acid, Salicylic acid and Phthalic acid) and diazonium compounds.

Unit-5 **06 Hours**

Polynuclear Aromatic compounds: Chemistry of naphthalene, and their derivatives, aromatic compounds and aromatics Huckel's rule, structure of benzene, aromatic substitution electrophilic and nucleophilic reactions and their mechanism.

Unit-6 **07 Hours**

Stereochemistry: Stereochemistry of compounds having two asymmetric carbon atoms, Inter conversion of newman, sawhorse, fischer projections, D, L, Nomenclature R,S, E,Z-Nomenclature, Enantiomers, Diastereomers, Racemic mixture, separation of isomers from racemic mixture, Walden inversion etc.

Unit-7 **05 Hours**

Outlines of Biochemistry: Carbohydrates: classifications, stereo & chemical reactions of glucose, fructose and starch etc., introduction to enzymes, vitamins and coenzymes, lipids.

Text books/Reference Books:

1. ArunBahl and B. S. Bahl, A Text book of Organic Chemistry, S.Chand and Company.
2. Michael B Smit and Jerry March, March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure, John Wiley & Sons.
3. I.L.Finar, Organic Chemistry Vol. I & II, Longmans Green & Co.

Inorganic and Organic Chemistry Lab:

10-12 experiments based on the syllabus covered as above will be performed and evaluated on continuous basis.

Textbooks/ References:

1. A.I. Vogel: Textbook of Practical Organic Chemistry, 5th edition, Prentice Hall.
2. F. G. Mann & B. C. Saunders, Practical Organic Chemistry, Orient Longman.

Evaluation Scheme:

Continuous evaluation process comprising of components like attendance, assignment, class tests, practical, comprehensive examinations, etc.

Date:

Indrashil University

School of Engineering

Fourth Semester, 2019-20

Course Syllabus

Course Code:	**HS 401**
Course Title:	**Engineering Economics**
Credit Structure (L-T-P-C):	**2-0-0-0**
Instructor in Charge:	

Scope and Objective:

At the end of the course, the students will be able:

- To impart knowledge, with respect to concepts, principles and practical applications of Economics.
- To know the tactics of demand and supply of the market
- To understand the different market and its implications

Learning Outcome of the Course:

After learning the course the students should be able:

- To explain the relation between Science, Engineering, Technology and Economics.
- To deal with current marketing terminologies.
- To discuss the Indian economy in broad and sector specific perspective.

Syllabus:

Unit-1 **06 Hours**

Definition of Economics – various definitions, Nature of Economic problem, Production possibility curve Economic laws and their nature. Relation between Science, Engineering, Technology and Economics. Concepts and measurement of utility, Law of Diminishing Marginal Utility, Law of equi-marginal utility – its practical application and importance.

Unit-2 **07 Hours**

Meaning of Demand, Individual and Market demand schedule, Law of demand, shape of demand curve, Elasticity of demand, measurement of elasticity of demand, factors affecting elasticity of demand, practical importance & applications of the concept of elasticity of demand.
Meaning of production and factors of production; Law of variable proportions, Returns to scale, Internal and External economics and diseconomies of scale.

Unit-3 **07 Hours**

Various concepts of cost – Fixed cost, variable cost, average cost, marginal cost, money cost, real cost opportunity cost. Shape of average cost, marginal cost, total cost etc. in short run and long run.
Meaning of Market, Types of Market – Perfect Competition, Monopoly, Oligopoly, Monopolistic Competition (Main features of these markets)

Unit-4 **04 Hours**

Supply and Law of Supply, Role of Demand & Supply in Price Determination, effect of changes in demand and supply on prices.

Unit-4 **06 Hours**

Nature and characteristics of Indian economy (brief and elementary introduction), Privatization – meaning, merits and demerits. Globalisation of Indian economy – merits and demerits. Elementary Concepts of VAT, WTO, GATT & TRIPS agreement.

Text Books:

1. Principles of Economics: P.N. Chopra (Kalyani Publishers).
2. Modern Economic Theory – K.K. Dewett (S.Chand)

Reference Books:

1. A Text Book of Economic Theory Stonier and Hague (Longman's Landon)
2. Micro Economic Theory – M.L. Jhingan (S.Chand)
3. Micro Economic Theory – H.L. Ahuja (S.Chand)
4. Modern Micro Economics : S.K. Mishra (Pragati Publications)
5. Economic Theory – A.B.N. Kulkarni & A.B. Kalkundrikar (R.Chand & Co.)
6. Indian Economy: Rudar Dutt & K.P.M. Sundhram

Evaluation Scheme:

Continuous evaluation process comprising of components like attendance, assignment, class tests, presentations, case studies, etc.

Grades and Reports:

Since it is non-credit course, the students should be qualified/ non-Qualified depending upon their marks and grades.

INDRASHIL UNIVERSITY

Course Name: Engineering Innovation Project

Course Code: CH405 **Course Credit: 01**

Instructor-in-charge: **L-T-P: 0-0-2**

Course Description:

The program requires each student to undertake a project with interdisciplinary group-size up to a maximum of 4 students. Each project group is supervised by up to a minimum of two faculty staffs. In Engineering Innovation Project (EIP), students will take CDIO initiative for their innovation. CDIO (Conceive-Design-Implement-Operate) is an innovative framework in the field of engineering that equips engineers with the knowledge in the state-of-the-art of technology. Conceive, design, implement and operate are the different components of research methodology for which the students have to perform during the incoming semesters III, IV, V and VI respectively. Total credit of this course is four with one credit in each semester. Followings are the steps that the groups of interdisciplinary students are required to follow to secure 4 credits.

1. **Conceive:** This is one of the basic components of CDIO initiative for project work. In this component, students have to conceive the idea of project through observations and literature reviews to define the problems to be solved. Conceive part of project work will be of one credit along with the duration of one semester (semester III).
2. **Design:** Whatever be the problems that were conceived in semester III will be continued to semester IV for designing/simulating/modeling of the defined objectives. This part of the project will also be of one credit for the duration of semester IV.
3. **Implement:** The implementation part will be done in V semester of the same credit 1. In this component, installation and testing will be required to be done for the designed project. The problems related to modeling and simulation can be implemented using different software.
4. **Operate:** In this component, output of solution of the well defined problems will be investigated or analyzed. Results so obtained after operating the installed system will be manipulated and validated with the previous research. This component has to be finished during semester VI and will be of 1 credit.

Course Objectives:

The Objectives of the course are:

- To introduce students to engineering projects.
- To provide students an opportunity to exercise their creative and innovative qualities in a group project environment.

- To excite the imagination of aspiring engineers, innovators and technopreneurs.
- To make students understand why innovation is integral to commercial success.
- To evaluated Innovation strategies and tactics through perspective ideation.

Course Outcomes:

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

- Demonstrate a sound technical knowledge of their selected project topic.
- Undertake problem identification, formulation and solution.
- Design engineering solutions to complex problems utilizing a systems approach.
- Conduct an engineering project
- Communicate with engineers and the community at large in written an oral forms.
- Demonstrate the knowledge, skills and attitudes of a professional engineer.

Evaluation Scheme:

The assessment of Engineering Innovation Project consists of assessment by supervisor in the following areas:

- Technical Knowledge and Skills
- Project Report
- Oral Presentation
- Attendance and Participation
- Interview
- Demonstration

1. **Conceive**

S. No.	Evaluation Component	Weightage	Date and Time
1	Synopsis of work plan	10%	One months after the commencement of semester III
2	Progress report/presentation-1	20%	Two months after the commencement of semester III
3	Progress report/presentation-2	20%	Three months after the commencement of semester III
4	Final Presentation/Viva	50%	End of semester III
Total		**100%**	

2. **Design**

S. No.	Evaluation Component	Weightage	Date and Time
1	Synopsis of design/drawing	10%	One months after the commencement of semester IV
2	Progress report/presentation-1	20%	Two months after the commencement of semester IV
3	Progress report/presentation-2	20%	Three months after the commencement of semester IV
4	Final Presentation/Viva	50%	End of semester IV
Total		**100%**	

3. **Implement**

S. No.	Evaluation Component	Weightage	Date and Time
1	Synopsis of installation	10%	One months after the commencement of semester V
2	Progress report/presentation-1	20%	Two months after the commencement of semester V
3	Progress report/presentation-2	20%	Three months after the commencement of semester V
4	Final Presentation/Viva	50%	End of semester V
Total		**100%**	

4. **Operate**

S. No.	Evaluation Component	Weightage	Date and Time
1	Synopsis of result extraction	10%	One months after the commencement of semester V
2	Progress report/presentation-1	20%	Two months after the commencement of semester V
3	Progress report/presentation-2	20%	Three months after the commencement of semester V
4	Final Presentation/Viva	50%	End of semester V
Total		**100%**	

Reference Book: NA