BIRLA INSTITUTE OF TECHNOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS) CURRICULUM

(Effective from Academic Session: Monsoon 2020)

NAME OF THE PROGRAMME

B.TECH. (CHEMICAL ENGINEERING - Plastics And Polymer)

NAME OF THE DEPARTMENT

CHEMICAL ENGINEERING

Institute Vision

To become a Globally Recognised Academic Institution in consonance with the social, economic and ecological environment, striving continuously for excellence in education, research, and technological service to the National needs.

Institute Mission

- To educate students at Undergraduate, Postgraduate, Doctoral, and Post-Doctoral levels to perform challenging engineering and managerial jobs in industry.
- To provide excellent research and development facilities to take up Ph.D. programmes and research projects.
- To develop effective teaching learning skills and state of art research potential of the faculty.
- To build national capabilities in technology, education, and research in emerging areas.
- To provide excellent technological services to satisfy the requirements of the industry and overall academic needs of society.

Department Vision:

To be a center of excellence for the provision of effective teaching/learning, skill development and research in the areas of chemical engineering and allied areas through the application of chemical engineering principles.

Department Mission

1) To educate and prepare graduate engineers with critical thinking skills in the areas of chemical engineering & polymer science and engineering, who will be the leaders in industry, academia and administrative services both at national and international levels.

2) To inculcate a fundamental knowledge base in undergraduate students which enable them to carry out post-graduate study, do innovative interdisciplinary doctoral research and to be engaged in long-life learning.

3) To train students in addressing the challenges in chemical, petrochemical, polymer and allied industries by developing sustainable and eco-friendly technologies.

Graduate Attributes

1. **Engineering Knowledge**: Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

2. **Problem Analysis**: Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

3. **Design/ Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.

4. **Conduct investigations of complex problems** using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.

5. **Modern Tool Usage**: Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.

7. **Environment and Sustainability**: Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to

comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long Learning**: Recognize the need for and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

Programme Educational Objectives (PEOs)

1. To understand and apply working knowledge of chemical engineering principles in independent research and development.
2. To implement the inter-perceptional skills of individuals in technical profession.
3. To prepare students for the employment in such industries as chemical, petroleum, and allied chemical industries.
4. To update technical know-how by self- learning besides learning a great deal by associating with professional bodies and alumni.
5. To develop an ability to succeed in the graduate competitive examinations and pursue higher studies in chemical engineering or lateral disciplines.

(A)Programme Outcomes (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

(B) Programme Specific Outcomes (PSOs)

1. To develop students' understanding of the core scientific, mathematical and engineering principles conceive and design processes to produce, transform and transport materials (chemical products) - beginning with experimentation in the laboratory and followed by implementation of technologies in full-scale production.

2. To prepare students for professional work in development, design, modelling, simulation, optimization and operation of chemical products and processes.

3. To prepare students with high scholastic attainment to enter graduate programs leading to advanced degrees in chemical engineering or in related professional, scientific, and engineering fields.

PROGRAMME COURSE STRUCTURE (ALL SEMESTERS)

Semester/ Session of Study (Recommended)	Course Level	Category of course	Course Code	Courses	Mode of delivery & credits *L-Lecture; T-Tutorial; P-Practical*			Total Credits *C-Credits*
					L (*Periods/week*)	**T** (*Periods/week*)	**P** (*Periods/week*)	**C**
FIRST (Monsoon)	**THEORY**							
	FIRST	**FS** ***(Foundation Sciences)***	**MA 103**	Mathematics - I	3	1	0	4
			PH 113	Physics	3	1	0	4
		GE ***(General Engineering)***	**EE 101**	Basics of Electrical Engineering	3	1	0	4
			CS 101	Programming for Problem Solving	3	1	0	4
	LABORATORIES							
	FIRST	**FS**	**PH 114**	Physics Lab	0	0	3	1.5
		GE	**CS 102**	Programming for Problem Solving Lab	0	0	3	1.5
		GE	**PE 101**	Workshop Practice	0	0	3	1.5
		MC (Mandatory Course)	**MC 101/102/ 103/104**	Choice of : NCC/NSS/ PT & Games/ Creative Arts (CA)	0	0	2	1
TOTAL								**21.5**

SECOND (Spring)	**THEORY**							
	FIRST	**FS**	**MA107**	Mathematics - II	3	1	0	4
			CH101	Chemistry	3	1	0	4
		GE	**ME101**	Basics of Mechanical Engineering	3	1	0	4
			EC101	Basics of Electronics & Communication Engineering	3	1	0	4
	LABORATORIES							
	FIRST	**FS**	**CH102**	Chemistry Lab	0	0	3	1.5
		GE	**EC102**	Electronics & Communication Lab	0	0	3	1.5
			ME102	Engineering Graphics	0	0	4	2
		MC	**MC105/ 106/107/ 108**	Choice of : NCC/NSS/ PT & Games/ Creative Arts (CA)	0	0	2	1
TOTAL								**22**
GRAND TOTAL FOR FIRST YEAR								**43.5**
THIRD (Monsoon)	**THEORY**							
	SECOND	**FS**	**MA203**	Numerical Methods	2	0	0	2
	FIRST		**CE101**	Environmental Sciences	2	0	0	2
	SECOND	**PC**	**CL201**	Thermodynamics	3	1	0	4

			CL203	Fluid Mechanics	3	0	0	3
			CL204	Chemical Process Calculations	2	1	0	3
			CL205	Mechanical Operations	3	0	0	3
			CL213	Macromolecular Science	3	0	0	3
	LABORATORIES							
	SECOND	**GE**	**IT202**	Basic IT Workshop	0	0	2	1
		FS	**MA204**	Numerical Methods Lab	0	0	2	1
		MC	**MC201/ 202/203/ 204**	Choice of : NCC/NSS/ PT & Games/ Creative Arts (CA)	0	0	2	1
TOTAL								**23**
FOURTH (Spring)	**THEORY**							
	SECOND	**GE**	**IT201**	Basics of Intelligent Computing	3	0	0	3
	FIRST	**FS**	**BE101**	Biological Science for Engineers	2	0	0	2
	SECOND	**PC**	**CL208**	Heat Transfer Operations	3	1	0	4
			CL215	Mass Transfer Operation - I	3	1	0	4
		HSS	**UHV2**	Understanding Harmony	2	1	0	3
		PE		Program Elective (PE-I)	3	0	0	3

		OE		Open Elective (OE-I)/MOOC	3	0	0	3
	LABORATORIES							
	FIRST	**GE**	**EE102**	Electrical Engineering Lab	0	0	3	1.5
	SECOND	**MC**	**MC205/ 206/207/ 208**	Choice of : NCC/NSS/PT & Games/ Creative Arts (CA)	0	0	2	1
		PC	**CL213**	Chemical Engineering Lab -I	0	0	3	1.5
TOTAL								**26**
FIFTH (Monsoon)	**THEORY**							
	FIRST	**HSS**	**MT123**	Business Communications	3	0	0	3
	THIRD	**PC**	**CL319**	Mass Transfer Operation - II	3	0	0	3
			CL302	Chemical Reaction Engineering-I	3	1	0	4
			CL334	Polymer Technology-I	3	0	0	3
		PE		Program Elective (PE-II)	3	0	0	3
		OE		Open Elective (OE-II)/MOOC	3	0	0	3

	LABORATORIES							
	THIRD	**PC**	**CL304**	Computer Aided Process Engineering Lab.	0	0	4	2
			CL305	Chemical Engineering Lab -II	0	0	4	2
TOTAL								**23**
SIXTH (Spring)	**THEORY**							
	THIRD	**PC**	**CL320**	Chemical Reaction Engineering - II	3	1	0	4
			CL 335	Chemical Process Technology	3	0	0	3
			CL312	Polymer Processing	3	0	0	3
		PE		Program Elective (PE-III)	3	0	0	3
		OE		Open Elective (OE-III)/MOOC	3	0	0	3
		MC	**MC300**	Summer Training - Mandatory	N/A			3
	LABORATORIES							
	THIRD	**PC**	CL 315	Polymer Technology Lab-I	0	0	3	1.5
			CL 317	Chemical Engineering Lab - III	0	0	3	1.5

TOTAL								**22**
	THEORY							
SEVENTH (Monsoon)	**FOURTH**	**PC**	CL 407	Polymer Technology-II	3	0	0	3
			CL 405	Process Control & Instrumentation	3	0	0	3
			CL 408	Elastomer Technology	3	0	0	3
		PE		Program Elective (PE-IV)	3	0	0	3
		OE		Open Elective (OE-IV)/MOOC	3	0	0	3
	SECOND	**MC**	**MT 204**	Constitution of India	2	0	0	NC
	LABORATORIES							
	FOURTH	**PC**	CL 402	Polymer Technology Lab-II	0	0	3	1.5
			CL 403	Plant Design	0	0	4	2
TOTAL								**18.5**
EIGTH (Spring)	**FOURTH**	**PC**	**CL 400**	Research Project / Industry Internship	**Total**			**12**
GRAND TOTAL *(Minimum requirement for Degree award)*								**168**

PROGRAMME ELECTIVES (PE)*
(OFFERED FOR LEVEL 1-4)

PE / LEVEL		Code no.	Name of the PE courses	Prerequisites courses with code	L	T	P	C
3	PE 1	CL221	Energy Engineering	CL201, CL311	3	0	0	3
3		CL222	Pollution Control Equipment Design	CL209, CL208, CL203	3	0	0	3
3		CL223	Colloid and Interfacial Science	CH101, PH101, CL209	3	0	0	3
3		CL224	Analytical Instrumental Methods	CH101, PH101	3	0	0	3
3		CL225	Fluid-Solid Operation	CH101, PH101, CL205, CL203	3	0	0	3
3	PE 2	CL321	Petroleum Refinery Engineering & Petrochemicals	CH101, PH101, CL209	3	0	0	3
3		CL322	Macromolecular Science	CH 101, PH101	3	0	0	3
3		CL323	Safety & Hazards in Process Industries	PH101, CH101, PH101	3	0	0	3
3		CL324	Computational Fluid Dynamics	CH101, PH101, CL205, CL203	3	0	0	3
3		CL325	Biomaterials	CH101, PH101	3	0	0	3
4	PE 3	CL326	Reservoir Engineering	CL203	3	0	0	3
4		CL327	Polymer Processing	CH101, PH101	3	0	0	3
4		CL328	Paints and Surface Coating Technology	CH101,PH101	3	0	0	3
4		CL329	Elastomer Technology	CH101, PH101	3	0	0	3
4		CL330	Natural Gas Engineering	CH101, PH101	3	0	0	3
4		CL333	Polymer Technology	CH101, PH101	3	0	0	3
4		CL332	Membrane Science & Technology	CH101, PH101	3	0	0	3
4	PE 4	CL421	Fibre Science & Technology	CH101, PH101	3	0	0	3
4		CL422	Polymer Composite	CH101, PH101	3	0	0	3
4		CL423	Introduction to Microelectronics Fabrication	CH101, PH101	3	0	0	3

4		CL424	Microfluidics	CL203	3	0	0	3
4		CL425	Plastic Packaging Technology	CH101, PH101	3	0	0	3
4		CL426	Chemical Process Intensification	CL208, CL209, CL301, CL302, CL306	3	0	0	3
4		CL427	Computer Aided Process Engineering	CL208, CL209, CL301, CL302, CL306, CL307	3	0	0	3

*** PROGRAMME ELECTIVES TO BE OPTED ONLY BY THE DEPARTMENT STUDENTS**

OPEN ELECTIVES (OE)**
(OFFERED FOR LEVEL 1-4)

OE / LEVEL	Code no.	Name of the PE courses	Pre-requisites	L	T	P	C
OE/1	CL224	Analytical Instrumental Methods	NIL	3	0	0	3
OE/1	CL221	Energy Engineering	NIL	3	0	0	3
OE/2	CL323	Safety & Hazards In Process Industries	NIL	3	0	0	3
OE/2	CL322	Macromolecular Science	NIL	3	0	0	3
OE/2	CL325	Biomaterials	NIL	3	0	0	3
OE/3	CL330	Natural Gas Engineering	NIL	3	0	0	3
OE/3	CL328	Paints and Surface Coating Technology	NIL	3	0	0	3
OE/4	CL422	Polymer Composites	NIL	3	0	0	3
OE/4	CL423	Introduction to Microelectronics Fabrication	NIL	3	0	0	3

**** OPEN ELECTIVES TO BE OPTED ONLY BY OTHER DEPARTMENT STUDENTS**

In-depth Specialization in Chemical Process Engineering

Students who have registered for ***B. Tech in Chemical Engineering*** should complete 20 credits opting courses listed below. The credits shall be over and above minimum requirement for degree award. Courses shall be selected from single specialization area only.

Semester/Session of Study (Recommended)	**Course Level**	**Category of course**	**Course Code**	**Courses**	**Mode of delivery & credits L-Lecture; T-Tutorial; P-Practical**			**Total Credits *C - Credits***
					L	**T**	**P**	**C**
FIFTH (Monsoon)		**THEORY**						
	Third	**DS**	**CL361**	Multiphase flow	3	0	0	3
			CL324	Computational Fluid Dynamics	3	0	0	3
		DS	**CL364**	Mini Project - 1	0	0	4	2
TOTAL								**8**
SIXTH (Spring)		**THEORY**						
	Third	**DS**	**CL363**	Molecular Simulation	3	0	0	3
			CL362	Process Integration	3	0	0	3
		DS	**CL365**	Mini Project - 2	0	0	4	2
TOTAL								**8**
SEVENTH (Monsoon)		**THEORY**						
	Fourth	**DS**	**CL426**	Project & Viva	0	0	8	4
TOTAL								**4**
GRAND TOTAL								**20**
(Minimum requirement for in-depth specialization award)								

In-depth Specialization in Polymer Technology

Students who have registered for ***B. Tech in Chemical Engineering*** should complete 20 credits opting courses listed below. The credits shall be over and above minimum requirement for degree award. Courses shall be selected from single specialization area only.

Semester/Session of Study (Recommended)	Course Level	Category of course	Course Code	Courses	Mode of delivery & credits L-Lecture; T-Tutorial; P-Practical			Total Credits
					L	T	P	C
FIFTH (Monsoon)		THEORY						
	Third	DS	CL322	Macromolecular Science	3	0	0	3
			CL366	Polymer Technology - 1	3	0	0	3
		DS	CL364	Mini Project – 1	0	0	4	2
TOTAL								8
SIXTH (Spring)		THEORY						
	Third	DS	CL367	Polymer Processing	3	0	0	3
		DS	CL368	Polymer Technology - II	3	0	0	3
		DS	CL365	Mini Project - 2	0	0	4	2
TOTAL								8
SEVENTH (Monsoon)								
	Fourth	DS	CL426	Project & Viva	0	0	8	4
TOTAL								4
GRAND TOTAL *(Minimum requirement for in-depth specialization award)*								20

Minor in Chemical Engineering
(Offered ONLY to OTHER department students)

Students who have registered for ***B. Tech Minor in Chemical Engineering*** should complete 20 credits and shall opt for courses listed below. Courses shall be selected from single specialisation area only.

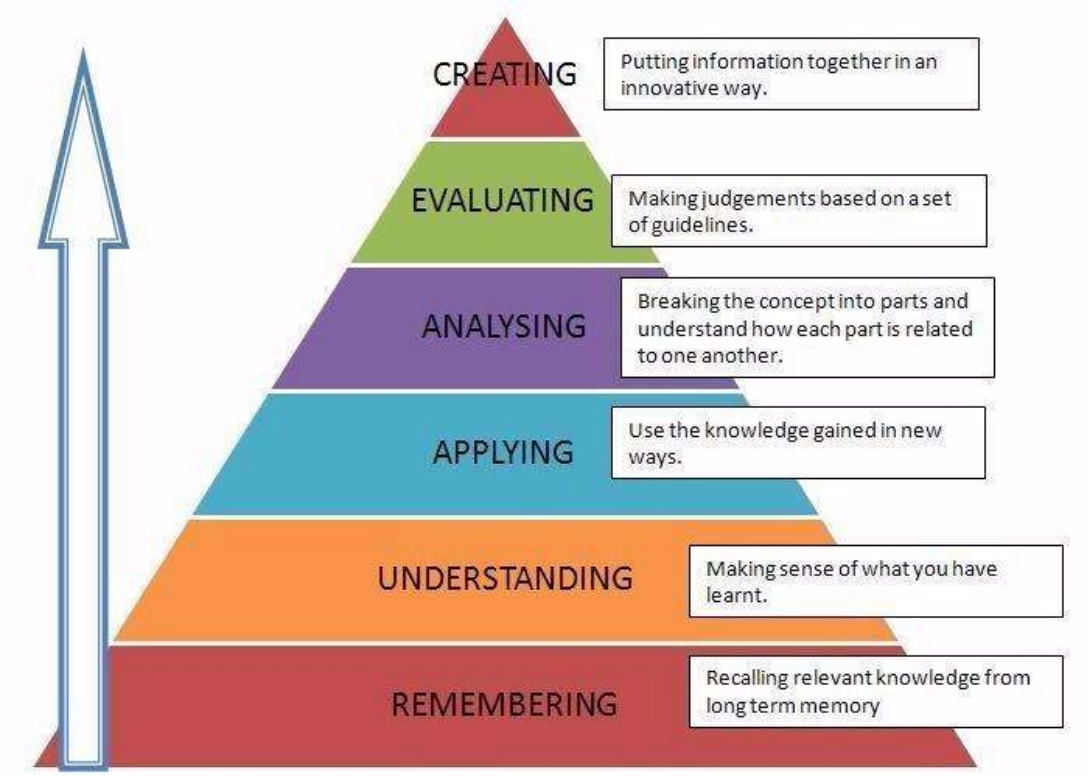
Semester/Session of Study (Recommended)	Course Level	Category of course	Course Code	Courses	Mode of delivery & credits L-Lecture; T-Tutorial; P-Practical			Total Credits
					L	T	P	C
FIFTH (Monsoon)		**THEORY**						
	Second	**PC**	**CL216**	Unit Operation-I	3	0	0	3
	Third		**CL341**	Fundamentals of Chemical Reaction Engineering	3	0	0	3
TOTAL								**6**
SIXTH (Spring)		**THEORY**						
	Second	**PC**	**CL217**	Unit Operation-II	3	1	0	4
	Third		**CL342**	Mini Project	0	0	4	2
TOTAL								**6**
SEVENTH (Monsoon)		**THEORY**						
	Third	**PC**	**CL343**	Unit Operation-III	3	1	0	4
	Third		**CL344**	Project & Viva	0	0	8	4
TOTAL								**8**
GRAND TOTAL *(Minimum requirement for minor degree award)*								**20**

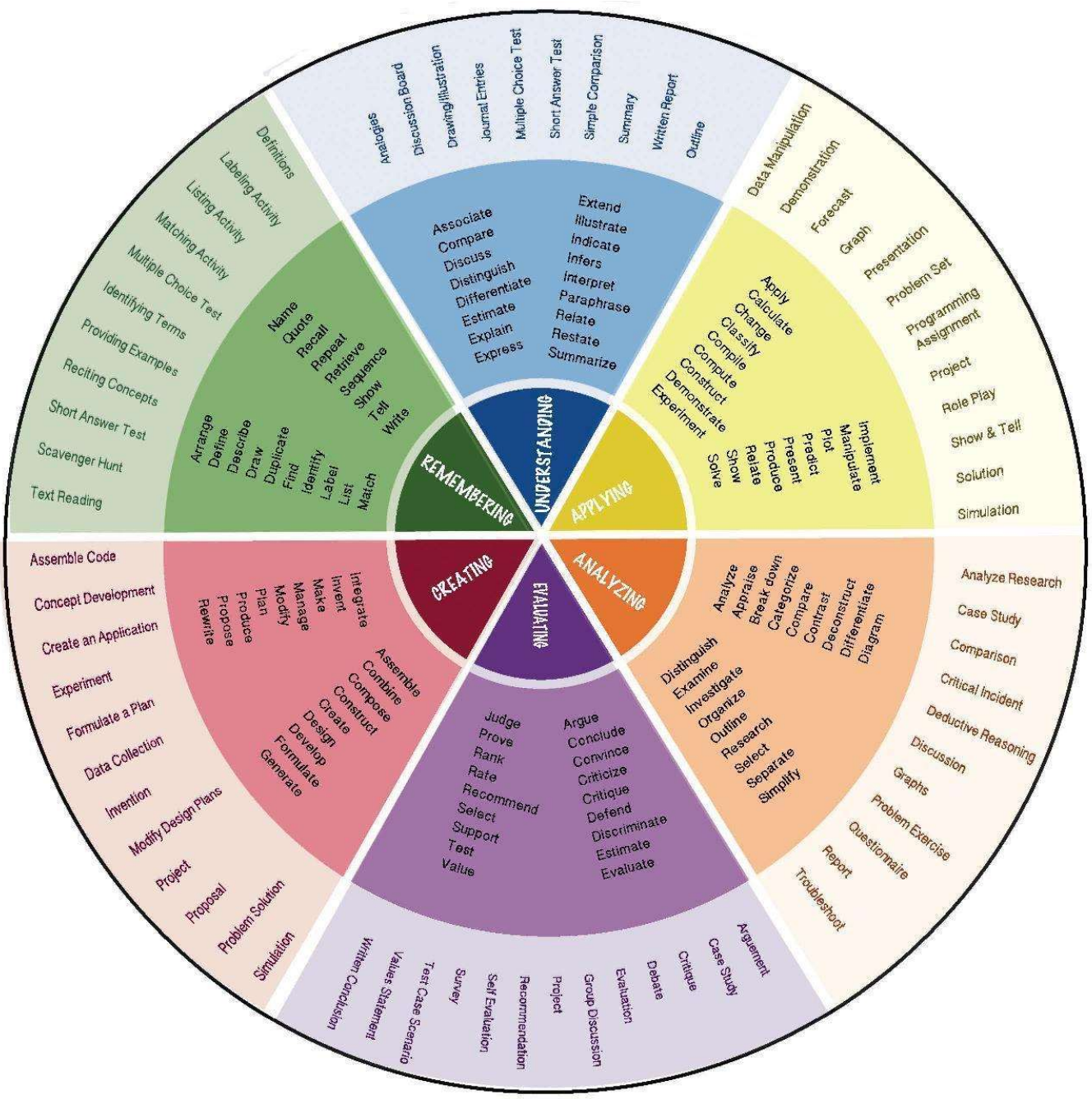
* Two courses out of three are compulsory.

BLOOM'S TAXONOMY FOR CURRICULUM DESIGN AND ASSESSMENT:

Preamble

The design of curriculum and assessment is based on Bloom's Taxonomy. A comprehensive guideline for using Bloom's Taxonomy is given below for reference.




REMEMBERING
UNDERSTANDING
APPLYING
ANALYZING
EVALUATING
CREATING
Definitions
Labeling Activity
Listing Activity
Matching Activity
Multiple Choice Test
Identifying Terms
Providing Examples
Reciting Concepts
Short Answer Test
Scavenger Hunt
Text Reading
Name
Quote
Recall
Repeat
Retrieve
Sequence
Show
Tell
Write
Arrange
Define
Describe
Draw
Duplicate
Find
Identify
Label
List
Match
Analogies
Discussion Board
Drawing/Illustration
Journal Entries
Multiple Choice Test
Short Answer Test
Simple Comparison
Summary
Written Report
Outline
Associate
Compare
Discuss
Distinguish
Differentiate
Estimate
Explain
Express
Extend
Illustrate
Indicate
Infers
Interpret
Paraphrase
Relate
Restate
Summarize
Data Manipulation
Demonstration
Forecast
Graph
Presentation
Problem Set
Programming Assignment
Project
Role Play
Show & Tell
Solution
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Demonstrate
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Predict
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Concept Development
Create an Application
Experiment
Formulate a Plan
Data Collection
Invention
Modify Design Plans
Project
Proposal
Problem Solution
Simulation
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Rewrite
Assemble
Combine
Compose
Construct
Create
Design
Develop
Formulate
Generate
Analyze
Appraise
Break down
Categorize
Compare
Contrast
Deconstruct
Differentiate
Diagram
Distinguish
Examine
Investigate
Organize
Outline
Research
Select
Separate
Simplify
Analyze Research
Case Study
Comparison
Critical Incident
Deductive Reasoning
Discussion
Graphs
Problem Exercise
Questionnaire
Report
Troubleshoot
Judge
Prove
Rank
Rate
Recommend
Select
Support
Test
Value
Argue
Conclude
Convince
Criticize
Critique
Defend
Discriminate
Estimate
Evaluate
Written Conclusion
Values Statement
Test Case Scenario
Survey
Self Evaluation
Recommendation
Project
Group Discussion
Evaluation
Debate
Critique
Case Study
Argument